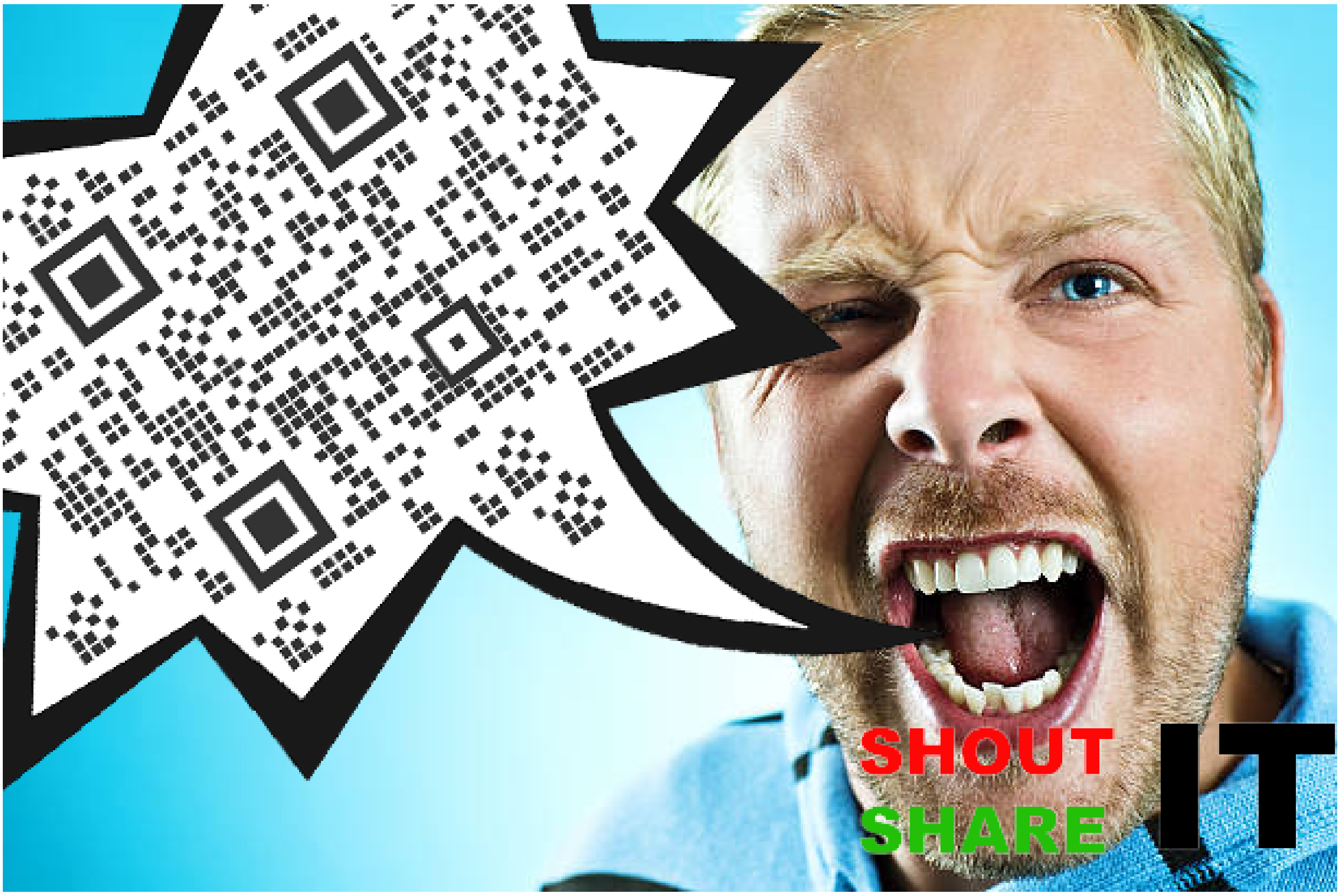
FOR·THE·INCREASE·
AND·DIFFVSION·OF·
KNOWLEDGE·AMONG·MEN·
PER
ORBEM
·SMITHSONIAN·
·INSTITVTION·
·WASHINGTON·1846·


SHOUT
SHARE
IT

SMITHSONIAN INSTITUTION
UNITED STATES NATIONAL MUSEUM
BULLETIN 82

A MONOGRAPH OF THE EXISTING CRINOIDS

BY
AUSTIN HOBART CLARK

VOLUME 1
THE COMATULIDS

PART 4c.—SUPERFAMILY TROPIOMETRIDA
(the families Thalassometridae and Charitometridae)

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1950

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price $2.25

ISSUED AUG 16 1950

SMITHSONIAN INSTITUTION
374227
OCT 11 1950
NATIONAL MUSEUM

PREFACE

Parts 3, 4, and 5 of Volume 1, Bulletin 82, include the systematic discussion of the species and higher groups of living comatulids, or unstalked crinoids. Part 3, published on March 21, 1931, included the account of the superfamily Comasterida. Part 4a, published on August 5, 1941, included the account of the superfamily Mariametrida, with the exception of the family Colobometridae. Part 4b, published on October 9, 1947, contained the account of the family Colobometridae of the superfamily Mariametrida, and of the families Tropiometridae, Calometridae, Ptilometridae, and Asterometridae of the superfamily Tropiometrida. Part 4c, the present one, is the concluding section of part 4. It is a continuation of Part 4b and includes the account of the two remaining families of the Tropiometrida, the Thalassometridae and the Charitometridae. Part 5, the concluding part of Volume 1, will be an account of the entire suborder Macrophreata.

CONTENTS

Page

- Preface iii
- Order Comatulida (continued) 1
  - Suborder Oligophreata (continued) 1
    - Superfamily Tropiometrida (continued) 1
      - Family Thalassometridae 1
        - Genus Stenometra 7
          - Stenometra dentata 8
          - Stenometra snelliusi 12
          - Stenometra quinquecostata 13
          - Stenometra diadema 18
        - Genus Daidalometra 23
          - Daidalometra eurymedon 24
          - Daidalometra arachnoides 25
          - Daidalometra hana 27
        - Genus Stylometra 29
          - Stylometra spinifera 30
        - Genus Cosmiometra 41
          - Cosmiometra leilae 43
          - Cosmiometra delicata 46
          - Cosmiometra dasybrachia 47
          - Cosmiometra aster 49
          - Cosmiometra philippinensis 52
          - Cosmiometra conifera 56
          - Cosmiometra crassicirra 58
          - Cosmiometra woodmasoni 60
          - Cosmiometra iole 61
          - Cosmiometra gardineri 63
        - Genus Parametra 64
          - Parametra compressa 65
          - Parametra granulata 69
          - Parametra orion 72
          - Parametra lisa 83
          - Parametra ajax 84
          - Parametra fisheri 86
        - Genus Lissometra 88
          - Lissometra alboflava 88
        - Genus Crotalometra 89
          - Crotalometra sentifera 91
          - Crotalometra rustica 92
          - Crotalometra magnicirra 97
        - Genus Koehlermetra 100
          - Koehlermetra porrecta 101
          - Koehlermetra flava 105
        - Genus Aglaometra 107
          - Aglaometra valida 109
          - Aglaometra incerta 114
          - Aglaometra propinqua 116
          - Aglaometra sulcata 118

Order Comatulida (continued)
  Suborder Oligophreata (continued)
    Superfamily Tropiometrida (continued)
      Family Thalassometridae (continued)

Page

- Genus Stiremetra 119
  - Stiremetra lusitanica 121
  - Stiremetra breviradia 126
  - Stiremetra perplexa 129
  - Stiremetra carinifera 130
  - Stiremetra acutiradia 132
  - Stiremetra decora 134
  - Stiremetra spinicirra 136
- Genus Oceanometra 137
  - Oceanometra gigantea 139
  - Oceanometra magna 142
  - Oceanometra annandalei 144
- Genus Leilametra 148
  - Leilametra necopinata 149
- Genus Thalassometra 151
  - Thalassometra bispinosa 154
  - Thalassometra electrae 156
  - Thalassometra agassizii 158
  - Thalassometra villosa 162
  - Thalassometra attenuata 163
  - Thalassometra hirsuta 165
  - Thalassometra margaritifera 168
  - Thalassometra marginata 168
  - Thalassometra hawaiiensis 170
  - Thalassometra latipinna 171
  - Thalassometra gracilis 173
  - Thalassometra echinata 176
  - Thalassometra peripolos 178
  - Thalassometra multispina 180
  - Thalsasometra setosa 182
  - Thalassometra omissa 184
  - Thalassometra sp. 185
- Genus Horaeometra 185
  - Horaeometra duplex 186

Family Charitometridae 191
- Genus Chondrometra 201
  - Chondrometra robusta 202
  - Chondrometra aculeata 204
  - Chondrometra rugosa 206
- Genus Monachometra 208
  - Monachometra patula 209
  - Monachometra flexilis 213
  - Monachometra robusta 216
  - Monachometra fragilis 219
- Genus Chlorometra 221
  - Chlorometra garrettiana 222

Order Comatulida (continued)
Suborder Oligophreata (continued)
Superfamily Tropiometrida (continued)

Page
Family Thalassometridae (continued) 227
Genus Glyptometra 230
Glyptometra timorensis 232
Glyptometra tuberosa 237
Glyptometra crassa 243
Glyptometra inaequalis 246
Glyptometra septentrionalis 249
Glyptometra distincta 254
Glyptometra investigatoris 259
Glyptometra macilenta 263
Glyptometra angusticalyx 266
Glyptometra sparksi 268
Glyptometra sclateri 271
Glyptometra levigata 272
Glyptometra lata 275
Glyptometra invenusta 276
Glyptometra lateralis 278
Glyptometra sp 279
Genus Crinometra 280
Crinometra brevipinna 290
var. insculpta 296
var. gracilis 297
var. pulchella 298
var. concinna 301
var. transversa 303
var. tuberosa 307
var. margaritacea 308
var. diadema 309
var. pourtalèsi 311
var. laevis 312
var. brevipinna 316
var. spinosa 318
var. gemmata 320
var. coronata 323
var. ornata 325
var. granulosa 326
var. granulifera 334
var. pulchra 335
var. angusta 347
Genus Charitometra 348
Charitometra basicurva 352
Charitometra incisa 354
Genus Poecilometra 355
Poecilometra acoela 359
Poecilometra scalaris 361
Genus Strotometra 362
Strotometra ornatissimus 363
Strotometra priamus 365
Stratometra parvipinna 368
Strotometra hepburniana 371
Index

A MONOGRAPH OF THE EXISTING CRINOIDS

By Austin Hobart Clark

Order COMATULIDA A. H. Clark (continued)

Suborder OLIGOPHREATA A. H. Clark (continued)

Superfamily Tropiometrida A. H. Clark (continued)

Family THALASSOMETRIDAE A. H. Clark

Basicurva group (in part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 102 (*Antedon valida*, *A. incerta*, *A. gracilis*, *A. lusitanica*, *A. breviradia*, *A. spinicirra*, *A. acutiradia*, *A. bispinosa*, *A. latipinna*, *A. multispina*, and *A. echinata; A. longicirra* is referable to the Asterometridae, *A. denticulata* to the Himerometridae, *A. pusilla* to the Antedonidae [Perometrinae], and the remaining species to the Charitometridae); for further references to this group see Part 4a, p. 180.

Spinifera group (in part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 211 (*Antedon quinquecostata*, *A. spinifera*, *A. duplex*, *A. lusitanica*, and *A. compressa; A. macronema* is referable to the Ptilometridae and *A. flexilis*, *A. patula*, *A. robusta*, *A. pourtalèsi*, and *A. brevipinna* to the Charitometridae); Journ. Linn. Soc. (Zool.), vol. 21, 1889, p. 308 (species compared with *Antedon andersoni* [=*Pontiometra andersoni;* Colobometridae]).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 13 (diagnosis; range; 12 species), p. 75 (diagnosis; remarks).—Bell, Proc. Zool. Soc. London, 1894, p. 399 (description of *Antedon bassett-smithi*, sp. nov. [=*Comatella stelligera*]), p. 400 (descriptions of *A. vicaria* [=*Mariametra vicaria*], *A. brevicirra* [=*Comaster distincta*], and *A. flavomaculata* [=*Stephanometra indica protectus*], spp. nov.), p. 401 (descriptions of *A. moorei* [=*Lamprometra palmata palmata*] and *A. fieldi* [=?], spp. nov.).—Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 136 (structural position).—Minckert, Arch. Naturg., Jahrg. 71, vol. 1, 1905, pp. 207, 225.—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 127, 129 (descriptions of new species); Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, pp. 343, 344 (characters differentiating this group not diagnostic), p. 359 (part of species included in *Thalassometra*, gen. nov.), p. 361 (most of the species not included in *Thalassometra* are included in *Charitometra*, gen. nov.).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, pp. 286, 309 (discussion), p. 310 (geographical distribution).

Granulifera group (in part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 239 (*Antedon multispina* and *A. porrecta;* the other species belong to the Charitometridae); for further references see p. 192.

Thalassometridae A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 136 (includes *Poecilometra*, *Thalassometra*, and *Charitometra*); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 210 (in key), p. 211 (includes *Thalassometra*, *Stylometra*, *Charitometra*, and *Poecilometra*; range; represented in the Hawaiian Islands), p. 212 (range of component genera); Proc. U. S. Nat. Mus., vol. 35, 1908, p. 120, fig. 19 (arm structure); Amer. Nat., vol. 42, No. 503, 1908, pp. 724, 725 (color); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 1 (revision; division into two subfamilies; descriptions of new genera); Proc. U. S. Nat. Mus., vol 36, 1909, p. 361 (part of *Antedon* of P. H. Carpenter), p. 362 (perfected ambulacral plating only in this family and in the Tropiometridae), p. 365 (covering plates in two rows instead of one as in *Comatilia*; side and covering plates found in the pentacrinoids); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 174 (referred to the Coma-

OCT 1 1950

tulida Oligophreata); Vid. Medd. Natur. Foren. København, 1909, p. 122 (solitary habit, correlated with the small, slowly developing eggs), p. 126 (characteristic of the Intermediate area), p. 152 (cirri compared with those of *Zygometra fluctuans* [=*comata*]), p. 182 (radial articular faces of *Asterometra* as in this family); Ann. and Mag. Nat. Hist., ser. 8, vol. 5, 1910, p. 360, fig. 2 (portion of a pinnule showing the side- and covering-plates for comparison with the "snow-shoes" of *Bonasa umbellata*); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 6 (8 species in African waters), p. 7 (species on northwest coast), p. 8 (species on west and southeast coasts), p. 10 (West Indian and corresponding East Indian genera), p. 649 (referred to the Oligophreata); Amer. Journ. Sci., ser. 4, vol. 32, No. 188, Aug. 1911, p. 130 (significance of the distinctive characters of *Ptilometra*); Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 438 (2 genera and 3 species in Australia); Mem. Australian Mus., vol. 4, 1911, p. 717 (proportion of the species of this family in Australia as known to P. H. Carpenter), p. 720 (proportion of the species of this family in Australia), p. 725 (*Asterometra* and *Pterometra* absent from Australia), p. 728 (raised to family rank from a subfamily and *Ptilometra*, *Pterometra*, and *Asterometra* assigned to it from the Tropiometridae), p. 729 (young differ widely from the adults), p. 730 (key to the Australian genera).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 286 (constitution; discussion).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 6 (number of East Indian genera; genera found also in the Atlantic; genera represented by closely allied genera in the Atlantic; exclusively East Indian genera; number of East Indian species), p. 10 (greatly developed in Japan), p. 11 (represented in the Ceylon region by *Pterometra*), p. 12 (represented in the Red Sea region by *Thalassometra*, in the southeast African region by *Thalassometra* and by *Cosmiometra*), p. 13 (East Indian and corresponding West Indian genera), p. 14 (characteristic of the Intermediate fauna, but 3 species are littoral), p. 23 (distribution in detail; 0–1,600 fathoms), p. 42 (*Ptilometra*, *Pterometra*, and *Asterometra* removed from the Tropiometridae to this family; raised from a subfamily to a family), p. 59 (key to the included genera).—Springer and Clark, Zittel-Eastman's Paleontology, 1913, p. 236 (in the Oligophreata).—A. H. Clark, Bull. Inst. Océanographique, Monaco, No. 294, 1914, pp. 7, 8 (temperature relations); Internat. Rev. gesamt. Hydrobiol. Hydrogr., 1914, pp. 4 and following (Atlantic and corresponding Indo-Pacific genera).—Alexander, Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 108.—A. H. Clark, Rec. Western Australian Mus., vol. 1, pt. 3, 1914, p. 115 (genus and species collected by the *Endeavour* in Western Australia); Journ. Washington Acad. Sci., vol. 5, No. 4, 1915, pp. 126–134 (phylogenetical and paleontological significance of the bathymetrical range); Die Crinoïden der Antarktis, 1915, p. 111 (synonymy; diagnosis; geological, geographical, bathymetrical, and thermal ranges), p. 132 (covering plates compared with those of *Promachocrinus* and related genera), p. 164 (represented in South Africa by *Crotalometra magnicirra*); Amer. Journ. Sci., vol. 40, 1915, p. 67 (detailed philosophical discussion of the bathymetrical range); Internat. Rev. gesamt. Hydrobiol. und Hydrographie, 1915, pp. 223 and following (detailed account of distribution of Australian species); Smithsonian Misc. Coll., vol. 65, No. 10, 1915, pp. 43 and following (phylogenetic study); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 139 (key to the included subfamilies).—Mortensen, Studies in the development of crinoids, 1920, p. 3 (discussion of eggs and distribution).—A. H. Clark, Univ. Iowa Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (represented in the West Indies); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, p. 3.—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 9, 99.—A. H. Clark, The Danish *Ingolf*-Exped., vol. 4, No. 5, 1923, p. 40 (Atlantic genera and species), p. 48 (in key), p. 51 (key to the Atlantic genera).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 19, 30, 31, 35, 42, 79, 84, 85, 88, 90, 91, 97, 100, 166, 193, 231, 239, 280, 284; Vid. Medd. Dansk Naturh. Foren. København, vol. 83, 1927, p. 39.—Mortensen, Handbook of the echinoderms of the British Isles, 1927, p. 15, p. 16 (in key), p. 25 (northeast Atlantic species).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, pp. 6, 10.—Boone, Bull. Bingham Oceanographic Collection, vol. 1, art. 4, April 1928, p. 3.—H. L. Clark, Rec. South Australian Mus., vol. 3, No. 4, May 9, 1928, p. 368.—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 647.—Nobre, Echinodèrmes de Portugal, 1931, p. 159 (diagnosis), p. 163.—A. H. Clark, Ann. Mag. Nat. Hist., ser. 10, vol. 10, No. 58, Oct. 1932, p. 379; Rec. Indian Mus., vol. 34, pt. 4, Dec. 1932, p. 565.—Sieverts, Neues Jahrb. Mineral., Geol., und. Paläontol., vol. 69, Beilage-Band, Abt. B, 1932, p. 156, footnote.—Gislén, Vid. Medd. Dansk Naturh. Foren. København, vol. 93, October 26, 1933, p. 483.—A. H. Clark, Treubia, vol. 14, livr. 2, December 1933, p. 213.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20, 22, 23, 25, 27, 28, 43.—A. H. Clark, Temminckia, vol. 1, 1936, p. 313; John Murray Exped. 1933–34, Sci. Reports, vol 4, No. 4, 1936 (Jan. 1, 1937), pp. 92, 101, 103.—Gislén, Kungl. Svenska Vet. Handl., ser. 3, vol. 17, No. 2, Oct. 3, 1938, pp. 4, 17.—Nobre, Echinodèrmes de Portugal, 1938, p. 185.—H. L. Clark, Mem. Soc. Cubana Hist. Nat., vol. 15, No. 1, May 1941, p. 8.—A. H. Clark, Bernice P. Bishop Mus. Bull. 195, 1949, p. 74.

Thalassometridae with rounded and spiny rays and arm bases A. H. Clark, Amer. Nat., vol. 42, No. 500, 1908, p. 542 (characteristic of Oceanic area); Geogr. Journ., vol. 32, No. 6, 1908, p. 602 (same); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 495 (comparison of ambulacral plating with that of West Indian species of the *Fimbriata* group of *Actinometra*).

Thalassometrinae A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 2 (diagnosis and comparisons), p. 13 (revision of included genera); Vid. Medd. Naturh. Foren. København, 1909, p. 124 (multibrachiate condition fortuitous in most species), p. 136 (transition segment in cirri comparable to that in *Comatella stelligera*), p. 151 (transition segment comparable with that of *Zygometra fluctuans* [=*comata*]); Mem. Australian Mus., vol. 4, 1911, p. 728 (raised to family rank).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 286 (discussion).—A. H. Clark, Bull. Inst. Océanogr. Monaco, No. 294, 1914, pp. 7, 8 (temperature relations); Journ. Washington Acad. Sci., vol. 4, No. 19, 1914, pp. 559–563 (correlation of geographical and bathymetrical ranges); No. 20, 1914, p. 582 (relation to temperature of habitat); vol. 5, No. 4, 1915, pp. 126–134 (phylogenetical and paleontological significance of the bathymetrical range); Amer. Journ. Sci., vol. 40, 1915, p. 67 (detailed discussion of bathymetrical range); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 140 (in key; geographical and bathymetrical ranges), p. 145 (key to the included genera); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, pp. 3, 13.—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 85, 90.—Boone, Bull. Bingham Oceanographic Collection, vol. 1, art. 4, April 1928, p. 3.—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 647; Ann. Mag. Nat. Hist., ser. 10, vol. 10, No. 58, October 1932, p. 379; Rec. Indian Mus., vol. 34, pt. 4, December 1932, p. 565.

Thalassomètres A. H. Clark, Bull. Mus. Hist. Nat., Paris, No. 4, 1911, p. 255 (including *Ptilometra*, taken from the Tropiometridae).

Thalassometriden A. H. Clark, Die Crinoïden der Antarktis, 1915, p. 192 (species and genera of this family especially characteristic of the Intermediate fauna).

Diagnosis.—A family of the superfamily Tropiometrida in which the ventral perisome of the pinnules is protected by well-developed and conspicuous side- and covering-plates easily visible with a hand lens; P_1 is longer and stouter than P_2; and the cirri, usually long and slender, rarely of moderate length and rather stout, are composed of more than 25 segments of which the distal are usually much shorter than the proximal, broader than long, with prominent dorsal spines or carinate processes; a well-marked transition segment is usually present, beyond which the segments have the surface light in color and highly polished.

Geographical range.—From southern Japan, the western Aleutian Islands, the Hawaiian Islands, the Galápagos Islands, and Panamá to the Kermadec Islands and southeastern Australia (Bass Strait) westward to the east coast of Africa and the Crozet Islands, and in the Atlantic from Tristan da Cunha and Ascension northward to the Bay of Biscay, the Caribbean Sea, and the Bahamas.

Bathymetrical range.—From 22 to 2,925 meters.

Thermal range.—From 1.2° to 23.6° C.

Remarks.—The species of the family Thalassometridae, though diversified, are quite distinctive, the stiff pinnules with well developed side- and covering-plates, the enlarged P_1, which is always larger and often much longer than P_2, and the usually long and slender cirri which bear dorsal spines in the outer portion, making them easy to recognize. The species of *Parametra*, which have relatively short and stout cirri with few segments, bear considerable superficial resemblance to some of the species of the family Charitometridae, but the cirri have an exceptionally well-marked transition segment beyond which the segments are light in color with a polished surface and bear dorsal processes, and P_1, though not greatly enlarged, is longer than P_2. In *Leilametra* the cirri are very long and straight with numerous (up to 83) segments which do not bear dorsal processes; but P_1 is long and basically enlarged as in related genera.

The 14 genera included in the family Thalassometridae fall into three distinctive groups. In the first group, consisting of the genera *Stenometra, Daidalometra, Stylometra, Cosmiometra, Parametra*, and *Lissometra*, the arms are strongly compressed laterally and are sharply carinate, at least in the outer portion, and are always, except for individual variants in the genera *Daidalometra* and *Parametra*, more than 10 in number with all the division series 2; P_1 resembles P_2, but is longer and proportionately stouter. This group ranges from southern Japan and the Bonin and Hawaiian Islands to Queensland and westward to Ceylon and the Maldive Islands, and is represented by the genus *Stylometra* in the Caribbean Sea; it occurs in water of from 22 to 795 meters in depth. Four of the six genera (*Stenometra, Daidalometra, Parametra*, and *Lissometra*) are confined to the area between southern Japan, northern Australia, and the Sunda Islands. Of the other two, *Cosmiometra* covers the entire range of the group, occurring in the Hawaiian Islands, in Bass Strait between Australia and Tasmania, and in the Maldive Islands, with the related *Stylometra* in the Caribbean Sea.

In the second group, consisting of the genera *Crotalometra, Koehlermetra, Aglaometra, Stiremetra, Oceanometra, Leilametra*, and *Thalassometra*, the arms are rounded dorsally to the tip and are 10 or more in number, if more than 10 the IIBr series are 4(3+4) or both 4(3+4) and 2, or by occasional individual variation 2; P_1 is longer than the pinnules following and is usually much stouter basally with carinate processes on the segments; P_2 may be small and short like the segments following, or it may be intermediate in character between P_1 and P_3 in the larger species. This group ranges from southern Japan, the western Aleutian and Galápagos Islands and Panamá, to Fiji, the Kermadec Islands, and southeastern Australia, and westward to east Africa from Sokotra to the Crozet Islands; in the Atlantic it is found from Tristan da Cunha to the Bay of Biscay; it occurs in water of from 55 to 2,925 meters, the usual depth being considerably greater than in the case of the preceding group. Of the 7 genera included in this group two, *Thalassometra* and *Stiremetra*, are found practically throughout the entire range of the group; both are confined to very deep water; one, *Crotalometra*, ranges from the East Indies to southeastern Africa, being represented in the south and east Atlantic by the closely related *Koehlermetra;* one, *Oceanometra*, a close relative of *Thalassometra*, ranges from the East Indies to the Hawaiian Islands; one, *Aglaometra*, bearing much the same relation to *Stiremetra* that *Oceanometra* does to *Thalassometra*, ranges from the East Indies to the Kermadec Islands; and one, *Leilametra*, is known only from Lombok. But so little is known about the species of this group that any generalizations based upon the distribution of the various genera would be premature. For instance, no species are reported from the Caribbean Sea where some of the genera are certainly represented.

The third group, including only the genus *Horaeometra*, is characterized by the abrupt expansion of the third–fifth segments of the genital pinnules, which form a protecting roof over the gonads. The genus *Horaeometra* is confined to the Caribbean Sea, occurring in water of from 159 to 479 meters in depth.

History.—In Dr. P. H. Carpenter's *Challenger* Report published in 1888 the species of the family Thalassometridae known to him were distributed among the *Basicurva*, *Spinifera*, and *Granulifera* groups of the genus *Antedon*. The family Thalassometridae was established in 1908 to include the genera *Thalassometra*, *Poecilometra*, and *Charitometra*, the genus *Stylometra* being added later in the same year. In January 1909, the family Thalassometridae was divided into the subfamilies Thalassometrinae, including the genera *Stylometra*, *Thalassometra*, *Stenometra*, *Stiremetra*, *Parametra*, and *Cosmiometra*, all but the two first new, and Charitometrinae, the equivalent of the family Charitometridae as now understood.

In 1911 the subfamily Thalassometrinae was raised to family rank and *Ptilometra*, *Pterometra*, and *Asterometra* were transferred to it from the family Tropiometridae. In 1914 the family Thalassometridae was divided into the two subfamilies Ptilometrinae, including the genera *Ptilometra*, *Pterometra*, and *Asterometra*, and Thalassometrinae, including the remaining genera. In 1934 Prof. Torsten Gislén raised the subfamily Ptilometrinae to family rank, leaving the family Thalassometridae as herein understood.

KEY TO THE GENERA OF THE FAMILY THALASSOMETRIDAE

- a^1. Genital pinnules with no appreciable expansion of earlier segments.
  - b^1. Arms, at least in outer portion, laterally compressed and sharply carinate, the carination produced into a high crest or broad overlapping spine; arms more than 10 (or by individual variation 10) in number, the division series all 2; P_1 longer and proportionately stouter than P_2, though not otherwise different.
    - c^1. Division series and arm bases narrow and laterally compressed, gablelike in cross section like the outer brachials, the carination of the outer brachials being continued proximally to the centrodorsal; cirri long and slender.
      - d^1. Arms 20 in number, 65–100 mm. long in fully developed individuals (from Timor and the Moluccas north to the Bonin Islands and southern Japan; 141 [?95]–457 meters). **Stenometra** (p. 7)
      - d^2. Arms 10–18 (usually 10–15) in number, usually 60–65 mm. long (from Port Denison, Queensland, to Timor and north to southern Japan; 22–548 meters). **Daidalometra** (p. 23)
    - c^2. Division series and arm bases evenly rounded or more or less flattened dorsally, occasionally with a slightly raised middorsal line.
      - d^1. Cirri long and slender with more than 35 segments; division series and lower brachials usually more or less spinous, or at least bordered with fine spines; 20–30 arms.
        - e^1. Elements of the division series and lower brachials armed with numerous prominent spines, at least along their borders; brachials beyond the proximal each with a long, thin, broad, and prominent curved overlapping spine (Caribbean Sea; 102–508 [?548] meters)-- **Stylometra** (p. 29)
        - e^2. Elements of the division series and lower brachials smooth or with bands of minute spines along their borders; carination of the brachials not produced into overlapping spines (from southern Japan and the Hawaiian Islands to southeastern Australia and westward to Ceylon, the Maldive Islands, and Saya de Malha; 183 [?128]–730 [?740] meters)-- **Cosmiometra** (p. 41)
      - d^2. Cirri shorter and stouter with not more than 35 segments; division series and lower brachials smooth, or with the lateral borders roughened or coarsely granular.
        - e^1. Cirri with at most 27 (usually 20–25) segments, short and stout; division series and arm bases well rounded dorsally, appearing narrow and only slightly flattened against their

neighbors; 10–20 arms (from southern Japan and the Hawaiian Islands to the Philippines, Moluccas, and Kei Islands; 128–795 meters)------------**Parametra** (p. 64)

e^2. Cirri with 30–34 segments, of moderate length and moderately slender; division series and arm bases very slightly convex dorsally but with a prominent sharp median carinate process, everywhere in close lateral apposition; lateral portion of the distal border of the IBr$_1$, IIBr$_1$, and first brachials forming thin rounded anterior processes which imbricate over the bases of the ossicles following; 13–15 arms (southwestern Japan; 188 meters)--------------------------------------**Lissometra** (p. 88)

b^2. Arms dorsally rounded to the tips, never carinate; arms 10 or more in number, the IIBr series when present 4(3+4) or 4(3+4) and 2, exceptionally by individual variation all 2; P_1 usually much enlarged, very stout and much broadened basally.

c^1. Cirri recurved at the tip or in the outer portion, the distal segments always carinate dorsally, the carination usually raised into a prominent broad dorsal spine; opposing spine always present.

d^1. Division series and arm bases smooth and without spines, though the lateral edges may be everted and tubercular or serrate.

e^1. Arms more than 15 (normally 20) in number; large and stout, with the arms 75–160 mm. long.

f^1. First syzygy following a IIBr 4(3+4) series between brachials 3+4; cirri in 10 definite columns; cirri long and slender with more than 50 segments (from Formosa, the Philippines, and the Malay Archipelago westward to the Maldive and Laccadive Islands and southeastern Africa; 55–1,595 [?2,047] meters)----**Crotalometra** (p. 89)

f^2. First syzygy following a IIBr 4(3+4) series between brachials 2+3; stouter, with stouter and shorter cirri which have not more than 50 (30–50) segments; cirri in 15 indefinite columns (from Ascension Island to the Bay of Biscay; 768–1,420 meters).
Koehlermetra (p. 100)

e^2. Arms not more than 15 (usually 10) in number.

f^1. Larger and stouter; 10 arms 90–150 mm. long; cirri 45–90 mm. long with 59–70 segments; IBr series and arm bases usually broadly rounded dorsally (from the Philippines to Ceram and the Kermadec Islands; 457–1,165 [?1,264] meters).
Aglaometra (p. 107)

f^2. Smaller and more slender; 10–14 (but rarely more than 10) arms 45–80 mm. long; cirri 17–50 mm. long with 30–66 segments; IBr series and arm bases carinate or subcarinate (from the Hawaiian Islands to Fiji, the Kermadec Islands, and southeastern Australia westward to the Laccadive Sea; from the Canary Islands to Cape Carvoeiro, Portugal; 649 [?640]–2,468 meters)-------------------------**Stiremetra** (p. 119)

d^2. Division series and arm bases more or less thickly beset with small spines or tubercles, at least laterally.

e^1. Arms 15–28 in number 90–180 mm. long; a more or less prominent middorsal keel on one or both the elements of the division series and first two brachials (from western Timor and the Kei Islands to the Philippines and Hawaiian Islands; 55–786 [?872] meters).
Oceanometra (p. 137)

e^2. Arms less than 15 (usually 10) in number (from southern Japan, the western Aleutian, Hawaiian, and Galápagos Islands, Panamá, and the Kermadec Islands westward to east Africa from Sokotra to the Crozet Islands; and from Tristan da Cunha and Ascension northward to the Canary Islands; 598–2,925 meters)--------**Thalassometra** (p. 151)

c^2. Cirri nearly straight, not recurved at the tip, tapering to a fine point, without dorsal spines or carination and without an opposing spine, about half the length of the arms; 10 arms about 180 mm. long (south of Lombok; 1,097 meters)--------------------**Leilametra** (p. 148)

a^2. Genital pinnules with the third-fifth segments greatly expanded, forming a roof over the gonads; small and rather delicate with 10–22 (usually 15–20) arms 40–50 mm. long and 30–50 (usually 30–40) cirrus segments (Caribbean Sea; Cuba to St. Vincent and ?Grenada; 159–479 meters).
Horaeometra (p. 185)

Genus STENOMETRA A. H. Clark

Antedon (part) P. H. Carpenter, *Challenger* Reports, Zool., vol. 26, pt. 60, 1888, p. 215, and following authors.

Thalassometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360.

Stenometra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14 (dlagnosis; genotype *Antedon quinquecostata* P. H. Carpenter, 1888); Vid. Medd. Naturhist. Foren. København, 1909, p. 193 (probably occurs at Singapore); Crinoids of the Indian Ocean, 1912, p. 9 (absent from Australia), p. 11 (absent from the west coast of the Malay Peninsula, the Andamans, and farther west), p. 24 (range), p. 59 (in key), p. 209 (original reference; type); Journ. Washington Acad. Sci., vol. 6, No. 5, 1916, p. 116 (comparison of arms with those of *Daidalometra*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 148 (in key; range), p. 156 (key to the included species).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 9, 115, 118; Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 7.—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, pp. 647, 649.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Diagnosis.—A genus of Thalassometridae in which the division series, which are all 2, and arms are laterally compressed and sharply carinate, gablelike in cross section, the brachial carination being produced into high crests or broad overlapping spines; the arms in fully developed individuals are normally 20 in number, 65–100 mm. long; there is no appreciable expansion of the earlier segments of the genital pinnules; P_1 resembles P_2 but is somewhat longer and proportionately stouter; the cirri are long, slender, and delicate, 25–75 mm. long with 50–90 segments, and are arranged in 10 columns on the small conical or truncated conical centrodorsal.

Geographical range.—From Timor and the Moluccas north to the Bonin Islands and southern Japan from the Korean Straits to Sagami Bay.

Bathymetrical range.—From 141 (?95) to 457 meters.

Thermal range.—From 11.3° to 15.9° C.

Remarks.—The genus *Stenometra* as herein understood includes four species. One of these, the very spiny *S. dentata* from the Bonin Islands, appears to be quite distinct from the others, although *S. snelliusi* from Ceram is to a certain extent intermediate between it and the other two. *Stenometra diadema* is the Japanese representative of the East Indian *S. quinquecostata* from which it seems always to be distinguishable though the differences are slight.

History.—The first known species of this genus was described under the name of *Antedon quinquecostata* by Dr. P. H. Carpenter in 1888. It was transferred to the new genus *Thalassometra* upon its establishment in 1907. In 1909 I proposed the genus *Stenometra* with *Antedon quinquecostata* P. H. Carpenter, 1888, as the genotype, listing as the included species *conifera* Hartlaub, *diadema* A. H. Clark, *hana* A. H. Clark, and *quinquecostata* P. H. Carpenter, all of which had been originally described in the genus *Antedon*. Later in 1909 *conifera* was transferred to the genus *Cosmiometra*, and in 1916 *hana* was selected as the genotype of the new genus *Daidalometra*, the combination *Daidalometra hana* having appeared without any explanation in 1915.

KEY TO THE SPECIES IN THE GENUS STENOMETRA

a^1. Proximal and distal edges of the elements of the division series and lower brachials not swollen or everted, and sparsely or not at all spinous or denticulate; few or no spines on the lateral portions of the elements of the division series and arm bases; cirri slender, the longest segments at least twice as long as broad.

b^1. Keels on the elements of the division series with the crest coarsely dentate, that on the IBr$_1$ strongly bidentate (southern Japan from the Korean Straits to Sagami Bay; 141[?95]–311 meters)---**diadema** (p. 18)

b^2. Keels on the elements of the division series with the crest straight (from the Philippines to the Moluccas and Timor; 183–457 meters)---------------------------**quinquecostata** (p. 13)

a^2. Proximal and distal edges of the elements of the division series and lower brachials everted and denticulate or spinous; lateral portions of the elements of the division series and lower brachials conspicuously spinous; cirri stouter, the longest segments not more than half again as long as broad.

b^1. Elements of the division series and lower brachials with the proximal and distal borders everted, very strongly produced, and lobate or coarsely spinous; brachials as far as the fifteenth or twentieth with a supplementary prominence on each side of the median keel; lateral borders of the elements of the division series and lower brachials with numerous long tubercles or spines (Bonin Islands; 183–210 meters)---------------------------------**dentata** (p. 8)

b^2. Elements of the division series and lower brachials with the proximal and distal borders swollen and irregular but not produced, more or less tubercular, armed with scattered spines; no supplementary prominences on the earlier brachials; lateral borders of the elements of the division series and earlier brachials with a conspicuous development of short spines (north of western Ceram; about 200 meters)---------------------------------**snelliusi** (p. 12)

STENOMETRA DENTATA Gislén

Stenometra dentata Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 115 (description; Bock's stations 55, 56, 59; notes and comparisons), figs. 87–91, p. 112, pl. 1, fig. 7; Zool. Bidrag Uppsala, vol. 9, 1924, pp. 14, 80, figs. 107, 108, p. 87 (synarthrial faces); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Diagnostic features.—The elements of the division series and first two brachials have the proximal and distal edges everted and strongly produced, lobate or coarsely spinous, and the lateral borders with numerous long tubercles or spines; and the brachials as far as the fifteenth or twentieth have a supplementary prominence on each side of the median keel. The 15–20 (usually 20) arms are 60–65 mm. long, and the longest cirri are 25–34 mm. long with 56–76 segments.

Description.—The centrodorsal is cylindrical with the flattened dorsal pole beset with small spines. The diameter of the dorsal surface is 2 mm., and the height of the free part of the centrodorsal is 1.5 mm. The cirrus sockets are arranged in five radial groups, the groups in more or less evident alternating columns, which are separated interradially by bare strips.

The cirri are XXIV, 74–76, 25–34 mm. long. The first segment is short with a distal collar which, especially ventrally, has a somewhat serrate edge. The second and third segments are twice as broad as long, similar to the first but with a more slightly developed distal collar. The fourth and fifth segments are about as long as broad or a little longer than broad. The sixth–tenth segments are half again as long as broad, slightly constricted centrally. The first–seventh segments have a small ventral spine, slightly projecting in lateral view, because of the collar mentioned above. The eighth–thirteenth (or –sixteenth) segments are smooth, those following with a dorsal spine. The distal segments are from two to three times as broad as long. The dorsal spines are small, distinct, distally curved, their height from one-third to one-fourth the width of the segments. The opposing spine is somewhat stouter, its height equal to half the width of the penultimate segment. The terminal claw is about as long as the penultimate segment.

The radials are narrowly bandlike, interradially somewhat bent outward by the interradial stripes on the centrodorsal. The IBr$_1$ are four times as broad as long, with a median carination and provided both proximally and distally with a vertical 4–5-lobed calcareous plate composed of the produced and everted ends of the ossicle. The IBr$_2$ (axillaries) are twice as broad as long, rhomboidal, in the proximal portion with a well-defined strong median tooth appearing in lateral view as a high bidentate crest which, together with the disto-median tubercle of the IBr$_1$, forms a strong synarthrial tubercle. The distal edge of the IBr$_2$ is obtusely angled with 6 or 7 pointed prominences. The IIBr series are 2, similar to the IBr series but with smaller and weaker synarthrial tubercles.

The probably 20 arms are 65 mm. long, indistinctly flattened laterally. The first six brachials are smooth, but bear both proximally and distally prominent lamelli-shaped lobate prominences similar to those on the ossicles of the division series. In addition, the most proximal brachials are partly with a median dorsal prominence which more distally develops into a dorsal spine, and partly with a pair of similar mediolateral prominences alternately most developed on the left and on the right sides. These lateral tubercles, situated on both sides of the median dorsal spine, disappear at the fifteenth to twentieth brachials, and from this point onward only the median dorsal spine remains. The distal brachials are rather strongly compressed laterally. About five of the terminal brachials have rudimentary pinnules.

Syzygies occur between brachials 3+4, and 22+23; or between brachials 3+4, 35+36, etc., with a distal intersyzygial interval of 6–11 muscular articulations.

P_1 is 8 mm. long with 12 or 13 segments of which the first 5–7 are concave on the outside, the concavity bordered by a more or less lobate winglike prominence, and the sixth and following are a little longer than broad, smoother, with a smaller wing and somewhat spiny distal collars. P_2 is 5.5 mm. long with 11 segments. P_3 is 4.5 mm. long with 6 segments. P_4 is a little longer than P_3 with 7 segments. The distal pinnules are 5 mm. long with 12 segments of which the first and second are short and those following from half again to twice as long as broad, the two terminal short again. The pinnule segments are smooth, in the proximal portion triangular in section, in the distal rounded.

The disk is encrusted with coarse granules.

The soft parts are dark brown, the skeleton lighter brown.

Notes.—The preceding description, adapted from Gislén, is based upon a specimen from Bock's station 56 with probably 20 arms, but with two of the branches from a IBr axillary broken.

A specimen from Bock's station 56 has the cirri XX, 57–61, 20–25 mm. long; dorsal spines are developed from the twelfth segment onward. The arms are about 20 in number, 65 mm. long. The IBr axillary is rhomboidal. After about the tenth brachial the dorsal spine is the only remaining prominence.

Syzygies occur between brachials 3+4 and 31+32; or between brachials 3+4, 6+7, 32+33, etc. The distal intersyzygial interval is 8–11 muscular articulations.

P_1 is 7.5 mm. long with 13 segments. P_2 is 5 mm. long with 10 segments. P_3 is 4 mm. long with 8 segments. P_4 is 3 mm. long with 7 segments. P_5 is 3.5 mm. long with 8 segments. The distal pinnules are 6 mm. long with 11 segments.

Another specimen from station 56 has the cirri XXVII, 37–56, 14–24 mm. long. The dorsal surface of the centrodorsal is 1.5 mm. in diameter. The 20 arms are 50 mm. long. The processes on the brachials are shorter than in the specimen preceding. A single dorsal spine is developed from the tenth brachial onward. The arms are distinctly flattened laterally out to the fifth brachial. The distal intersyzygial interval is 13–16 muscular articulations. P_1 is 5.5–7.5 mm. long with 13–15 segments. P_2 is 4.5–5 mm. long with 9–11 segments. P_3 is 4–5 mm. long with 8–9 segments. The distal pinnules are 5 mm. long with 11 segments.

Another specimen from station 56 has the cirri XXI, 43–57, from 18 to about 22 mm. long; the first six cirrus segments have a real ventral spine; dorsal spines are developed from about the tenth to twentieth segments. The 15 arms are 45 mm. long. The median keel on the IBr axillary is somewhat lower than in the type specimen. The brachials beyond the sixth are without lateral prominences. There are about 90 brachials, of which about five of the terminal have rudimentary pinnules. The dorsal brachial spine is low. On the four arms on one postradial series the syzygies are as follows: (1) brachials 3+4, 35+36, and 56+57; (2) 3+4, 33+34, 44+45, and 53+54; (3) 3+4, 29+30; (4) 3+4, 30+31, and 43+44. The distal intersyzygial interval is 5–18 muscular articulations. P_1 is 4 mm. long with 12 segments of which the last 8 are collar-shaped with their distal edges overlapping; a similar condition, though not so marked, occurs on P_2, P_3, and P_4. P_2 is 3.5 mm. long with 9 segments. P_3 is 3 mm. long with 9 segments. P_4 is 3 mm. long with 8 segments. The distal pinnules are 5.5 mm. long with 12 segments.

Another specimen from station 56 has the cirri XVIII, 54–65, 25–30 mm. long. The 15 arms are 60–65 mm. long. A regenerate from a $IIBr_1$ has two small, still smooth, arms. P_1 is 4–6 mm. long with 8–13 segments. P_2 is 4 mm. long with 8 segments, P_3 is 3 mm. long with 7 segments. The distal pinnules are 5.5 mm. long with 9–10 segments.

A specimen from station 59 has the cirri XVIII, 62–65, 24–28 mm. long. The 16 arms are broken. The IIBr series are 2. P_1 is 5 mm. long with 13 segments. The disk is 6 mm. in diameter.

In another specimen from station 59 the cirri are XVII, 53–60, 23–28 mm. long. The arms are 15+, broken. The IIBr series are 2. P_1 is 6 mm. long with 13 segments. The disk is 7 mm. in diameter.

Another specimen from station 59 has the cirri XIV, 40–43, 15–18 mm. long, in one and a partial second row, hardly divided into groups. The dorsal surface of the centrodorsal is 1 mm. in diameter. The 12 arms are 40 mm. long. The calcareous lamellae on the proximal ossicles are only slightly serrate. A single dorsal spine is developed from the eighth brachial. On a postradial series with one IIBr 2 series the syzygies in the three arms are arranged as follows: (1) in the arm arising from the IBr axillary, between brachials 3+4, 16+17, 23+24, and distally at intervals of 5 muscular articulations; (2) in the inner arm from the IIBr axillary, between brachials 3+4, 21+22, and distally at intervals of 7–8 muscular articulations; (3) in the outer arm from the IIBr axillary, between brachials 3+4, 21+22, and distally at intervals of 8 muscular articulations. For the animal as a whole the distal intersyzygial interval is 5–8 muscular articulations. P_1 is 4–4.3 mm. long with 10 segments. P_2 is 3.5 mm. long with 9 segments. P_3 is 2.5 mm. long with 7 segments.

A specimen from station 55 has the cirri XV, 20–21, from 3.5 to 5 mm. long; the second segment has a small ventral spine, the third–fifth segments are twice as long as broad and constricted centrally, and those following are shorter, from the tenth onward about as long as broad or broader than long; from the sixth segment onward dorsal spines are developed that reach about one-fourth the width of the segments in height. The height of the opposing spine is equal to half the width of the penultimate segment.

The radials are twice as broad as long with a median crest and small distal prominences which are interradially fused and produced anteriorly separating the IBr_1. The IBr_1 are half again as broad as long with a median tubercle and laterodistal prominences; the IBr_2, and first and second brachials bear similar, still larger, lobate flanges. The IBr_2 (axillaries) are triangular, as long as broad, with a small cavity in the distal angle.

The 10 arms are 13 mm. long. The first two brachials are as high as broad, and the first syzygial pair (composed of brachials 3+4) is also as long as broad. From the fifteenth brachial onward a mediodorsal spine is developed. The left arm is often a little longer and better developed than the right, though in one case the reverse is true.

P_1 is 1 mm. long with 5 segments. P_2 and P_3, like P_b and P_c, are usually lacking. The distal pinnules are 2 mm. long with 10 segments.

Orals are present, their length being one-fourth the radius of the disk; only the acute angle remains, the base and the inner parts having been resorbed.

Remarks.—Professor Gislén wrote that in regard to the number of the cirrus segments this species is most closely related to *Stenometra diadema*, but it is well separated from this species by the formation of the centrodorsal, the shortness of the cirri when compared with the arms—the latter are at least twice as long as the cirri—and by the large and many prominences on the ossicles of the arm bases. In this feature this species approaches *Daidalometra hana*, the genus *Daidalometra* being properly distinguished from *Stenometra* only by a lesser number of arms. Professor Gislén considered *Stenometra dentata* to a certain extent a transition form between *Stenometra* and *Daidalometra*.

Localities.—Dr. Sixten Bock's Expedition to Japan, 1914, station 55; Bonin Islands; eastnortheast of Chichijima; 210 meters; shells and sand; August 15, 1914 [Gislén, 1922, 1924, 1934].

Dr. Sixten Bock's Expedition to Japan, 1914, station 56; Bonin Islands; east of the Channel; 210 meters; August 15, 1914 [Gislén, 1922, 1924, 1934] (1, U.S.N.M., E.1111).

Dr. Sixten Bock's Expedition to Japan, 1914, station 59; east-northeast of Anojima; 183 meters; August 15, 1914 [Gislén, 1922, 1924, 1934].

Geographical range.—Known only from the Bonin Islands.

Bathymetrical range.—From 183 to 210 meters.

History.—*Stenometra dentata* was described in detail in 1922 by Prof. Torsten Gislén from nine specimens that had been collected by Dr. Sixten Bock in the Bonin Islands in 1914, one at station 55, five at station 56, and three at station 59. In 1924 he discussed the arm division, synarthries, and syzygies of this species and figured the synarthrial faces. In 1934 he listed it among the species with the *Stenometra diadema* type of arm division.

STENOMETRA SNELLIUSI A. H. Clark

Plate 1, Figure 1

Stenometra snelliusi A. H. Clark, Temminckia, vol. 1, 1936, p. 295 (listed), p. 313 (description; *Snellius* station 253*), pl. 8, fig. 9.

Diagnostic features.—The elements of the division series and first two brachials have the proximal and distal borders swollen and irregular, though not especially produced, more or less tubercular or armed with scattered spines, and the lateral borders with a conspicuous development of short spines; and there are no supplementary dorsolateral processes on the earlier brachials. The 20 arms are 70 mm. long, and the cirri are 35 mm. long with 68–75 segments.

Description.—The centrodorsal is a short thick column about twice as broad as high, 3 mm. in diameter. The dorsal pole is concave and bears scattered and irregular more or less spinous or pointed tubercles. The cirrus sockets are arranged in ten crowded columns of two each.

The cirri are XX, 68–75, 35 mm. long. The first segment is about four times as broad as long and those following slowly increase in length to the seventh and eighth, which are from one-third to one-half again as long as broad. The tenth, eleventh, or twelfth is a transition segment, and is slightly longer than broad. The segments following continue to decrease in length so that those in the distal third of the cirri are very short, about two and one-half times as broad as long. On the segments following the transition segment the median portion of the distal dorsal edge gradually becomes more and more prominent, involving progressively more and more of the dorsal surface, so that the very short distal segments bear each a very high carinate spine. The earlier segments as far as the transition segment have their distal edge all around produced. Up to about the twelfth–fifteenth the segments have the middle of the ventral distal edge produced into a more or less conspicuous tooth. The cirri taper from the base to about the seventh segment, then much more slowly, and again more rapidly at the tip.

The radials are concealed in the median line, but are visible as broad low triangles in the interradial angles. Their edges are swollen and produced, and are irregular, more or less tubercular, and armed with scattered spines. The IBr_1 are about five times as broad as long, with the edges all around produced, and the distal and lateral edges sparsely spinous. The IBr_2 (axillaries) are rhombic, twice as broad as long, with the edges everted and sharply, coarsely, and very irregularly serrate, except near the midradial line, and the lateral angles very deeply and sharply serrate or spinous. The elements of the IBr series bear very high thin median keels with the crest finely or coarsely and irregularly serrate, or deeply notched. The IIBr series resemble the IBr series, but the proximal, distal, and inner borders of the ossicles are somewhat less spiny or irregular, while the outer borders, on the outside of the postradial series, bear numerous long, slender, and irregular spines. The crest of the high median carination is usually smooth, but may be finely serrate, or even coarsely dentate.

The 20 arms are 70 mm. long. The first brachials are about three times as broad as the median length, and are slightly longer exteriorly than interiorly. Their edges are narrowly everted and are usually smooth, except that the outer side of the outermost first brachial on each postradial series is coarsely and irregularly spinous. The second brachials are irregularly five sided. The inner side is about half as long as the outer, and the proximal border forms an obtuse angle with the apex in the median line.

The edges are thickened, but smooth. There is a short spine at each angle. The median keels of the first two brachials are lower than those on the preceding ossicles, and the crest is smooth and straight. The first syzygial pair (composed of brachials 3+4) is somewhat broader than long. The carinations on the hypozygal and epizygal are not continuous, that on the epizygal being displaced outwardly. The next four segments are irregularly oblong, about three times as broad as the median length. Those succeeding are very obliquely wedge-shaped, about twice as broad as the longer side, terminally becoming less obliquely wedge-shaped and about as long as broad. The arms are strongly compressed laterally, and the brachials are strongly carinate, the carination being produced distally into a conspicuous curved overlapping spine.

Syzygies occur between brachials 3+4, again from between brachials 29+30 to between brachials 47+48 (usually between brachials 35+36, or near that point), and distally at intervals of 5–7 (usually 6) muscular articulations.

P_1 is 7 mm. long with 14–15 segments, moderately stout and tapering evenly to the tip. The proximal outer side is strongly rounded. The ventral edges and the carinate line on each segment are produced into high thin processes with a straight or more or less convex crest. P_2 resembles P_1, and is nearly as long and large. P_3 is smaller and shorter, and the pinnules following are shorter still.

The color in alcohol is light brown, with the outer two-thirds of the cirri lighter.

Comparisons.—This species resembles *S. diadema* from southern Japan, but it is larger and stouter with stouter cirri which have somewhat stouter segments; the carinate processes on the division series are higher and more even, and there is a considerable and conspicuous development of spines interradially on the division series and arm bases.

Parasite.—A small parasitic gastropoid (?*Melanella*, sp.) was attached to one of the cirri (see Part 2, pp. 645–649).

Locality.—*Willebrord Snellius* station 253*; north of western Ceram (lat. 2°51′00″ S., long. 128°48′00″ E.); about 200 meters; April 28, 1930 [A. H. Clark, 1936] (1, L.M.).

History.—This species is known only from the single specimen dredged by the *Willebrord Snellius* in 1930 and described in 1936.

STENOMETRA QUINQUECOSTATA (P. H. Carpenter)

Plate 1, Figures 2, 3; Plate 2, Figures 4, 6, 7

[See also vol. 1, pt. 1, figs. 9, p. 65, 269, p. 259, 485, p. 365; pt. 2, figs. 820–822, p. 392, pl. 2, figs. 979, 980.]

Antedon quinquecostata P. H. Carpenter, *Challenger* Reports, Zool. vol. 26, pt. 60, 1888, p. 215 (description; *Challenger* station 192), pl. 3, fig. 6, *a–d*, pl. 38, figs. 1–3.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 77 (comparison with *A.* [*Cosmiometra*] *conifera*).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 34 (identity).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 309 (in *Spinifera* group; history), fig. 8, p. 364 (centrodorsal and radial articular faces).

Thalassometra quinquecostata A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed).

Stenometra quinquecostata A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 15 (listed); Vid. Medd. Naturh. Foren. København, 1909, p. 186 (compared with *S. dorsata* [*diadema*]); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 554 (compared with *S. dorsata* [*diadema*] and with *S. cristata*); Crinoids of the Indian Ocean, 1912, p. 34 (identity), p. 209 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 44 (notes on three *Challenger* specimens in the British Museum); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 156 (in key; range), p. 157

(references); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 647 (Rotti Strait, 100 fathoms; notes), p. 649 (compared with *S. diplax*).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 25.

Stenometra cristata A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 553 (description; *Albatross* station 5275); Crinoids of the Indian Ocean, 1912, p. 210 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 157 (in key; range; references).

Stenometra diplax A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 635 (listed), p. 647 (Rotti Strait, 100 fathoms; description; remarks), pl. 41, fig. 5; Proc. Biol. Soc. Washington, vol. 47, p. 10, Feb. 9, 1934 (new species discovered by *The Cable*).

Diagnostic features.—The elements of the division series and first two brachials have the proximal and distal edges unmodified, the lateral borders smooth or sparsely denticulate, and the median carination with the crest in profile straight. The 18–21 (usually 20) arms are 85–100 mm. long, and the cirri are 40–50 mm. long with 73–90 segments.

Description.—The centrodorsal is a short pentagonal column with five interradial ridges which are very prominent at the ventral ends. The cirrus sockets are arranged in more or less alternating double columns, three or four in each column, separated by the interradial ridges.

The cirri are about XXXV, 80–90, up to 45 mm. long. Some of the proximal segments are much longer than broad, but those following become shorter and laterally compressed with a sharp dorsal keel which passes into a prominent spine on the short middle and later segments.

The angles of the radials are just visible, being turned slightly outward above the interradial processes of the centrodorsal. The IBr_1 are short and sharply convex, rising to meet a strongly carinate backward process of the widely rhombic IBr_2 (axillaries). The IIBr and IIIBr series (when present) are 2. The elements of the division series have sharp median crests that are continued out onto the arms. All these ossicles, and especially those on the outer side of the postradial series, have straight lateral edges and sharply flattened sides. On some arms this feature ceases at the second brachial, though in others it is very visible on the first syzygial pair and even on the fifth brachial.

The arms are usually 20 in number (in one case 21), about 100 mm. long, with 120 or more brachials. The brachials have a sharp median keel and become much compressed laterally so that the later ones overlap rather sharply.

Syzygies occur between brachials 3+4, again from between brachials 21+22 to between brachials 26+27, and distally at intervals of 5–12 (usually 6–8) muscular articulations.

P_1 is moderately stout, about 10 mm. long, with 12–15 segments, most of which are longer than broad; the first 4 or 5 are flattened on their outer side where they meet the corresponding pinnule of adjacent arms, and their inner edges are also slightly cut away. The following pinnules are rather shorter with more rounded segments, the two at the base being wider than their fellows on the lower part of the arm. Farther out, however, this is less marked, and the pinnules are somewhat carinate, though never especially long.

The disk is 7 mm. in diameter and is moderately plated, the arms rather more so; the pinnule ambulacra have covering plates and partly differentiated side plates. Sacculi are rare or altogether absent.

The color in alcohol is yellowish brown or whitish brown, with the perisome darker.

The preceding description is adapted from the original description of Carpenter. In the British Museum I examined three of the *Challenger* specimens, two large ones and one small. The cirri are proportionately larger and stouter than those of the Japanese *S. diadema.* The arms are 100 mm. long. The sides of the division series are denticulate. The lateral portions of the proximal borders of the ossicles of the division series are also more or less denticulate. The crest of the carination is sharp, and nearly or quite straight; there is no pronounced denticulation.

Notes.—Three of the specimens from Menado Bay, Celebes, have the cirri 50 mm. long with 76–79, 74–75, and 75 segments. All the 18 specimens have apparently 20 arms.

Of the three specimens from Rotti Strait one has 19 and another 21 arms, all the division series being 2. The third specimen is curious in having eight of the nine IIBr series 4, in two synarthrial pairs, instead of the usual 2. It was described as a new species under the name of *Stenometra diplax* in the following terms: The centrodorsal is thick discoidal, about twice as broad at the base as high, 3 mm. in diameter basally. The very broad dorsal pole is studded with evenly distributed rather short and pointed papillae. The cirrus sockets are arranged in ten regular columns of two sockets each, there being two columns in each radial area. In the interradial lines the adjacent columns of cirrus sockets are separated by rather high ridges, in the midradial lines by narrower, lower, and sharper ridges.

The cirri are XX, 73–76, from 40 to 50 mm. long, very slender and delicate. The first segment is exceedingly short, and those following gradually increase in length to the fifth, which is half again as broad as long, the sixth, which is slightly longer than broad, and the seventh–twelfth, which are the longest, about one-third again as long as broad. Beyond the twelfth the segments very slowly decrease in length, so that those in the terminal third of the cirri are about twice as broad as long. Beginning somewhat before the middle of the cirri the distal ends of the segments become slightly produced dorsally. This production of the distal edge gradually narrows and at the same time extends proximally so that the short distal segments bear a prominent sharp median dorsal carination, the crest of which in profile at first rises gradually from the proximal to the distal end of the segment, but later becomes strongly convex. The opposing spine is conical, blunt, slightly higher than the process on the segment preceding. The terminal claw is scarcely as long as the penultimate segment, and is stout and strongly curved. The proximal segments are carinate ventrally, and the ventral and lateral portions of the distal edge are produced, overlapping the bases of the segments succeeding. This feature gradually dies away as the segments become shorter. In lateral view the cirri taper very slightly in the basal fourth and then remain of uniform width until near the end, when they taper gradually to the tip.

The ends of the basal rays are visible as minute tubercles at the upper ends of the interradial ridges on the centrodorsal.

The radials are extremely short, chevron-shaped, with the distal border narrowly and the lateral edges thickly everted and irregularly dentate. The IBr_1 are chevron-shaped, very narrow and bandlike, from six to eight times as broad as long. The proximal edge bears a few scattered teeth or lobes or other irregularities, and the lateral portions of the distal edge are more or less strongly dentate. The IBr_2 (axillaries) are rhombic, not quite twice as broad as long; the lateral angles are just in contact with those of their neighbors, and the distal and proximal angles are similar, the latter being somewhat more rounded. The proximal half of the median line carries a rather high sharp keel with a straight crest. Of the nine IIBr series present, eight are 4, the axillary in no case being united to the preceding ossicle by syzygy, and one is 2. The division series are narrow and high, gablelike in end view, and the middorsal line is occupied by a sharp and conspicuous, though not high, carination. The lateral borders of the ossicles may be sparsely denticulate, but the proximal and distal edges are unmodified. The division series are in very close apposition, and the sides of the component elements are sharply flattened.

Only the arm bases are preserved. There were at least 19 arms. The brachials are deep and much compressed laterally, with a low but sharp median carination, which is obscure on the earlier brachials, though becoming conspicuous as the brachials become triangular.

Although the occurrence of IIBr series of four elements instead of two would seem at first sight to be an important character sharply distinguishing this form from *S. quinquecostata*, it is undoubtedly only an aberrant specimen of the latter. The two were taken together, and they seem to agree in every other feature, though the present specimen is slightly smaller than those identified as *S. quinquecostata* and has somewhat more slender cirri. This would be likely to be the case, however, with any markedly aberrant individual. It is noteworthy that in the IIBr series the two distal elements are never united by syzygy, which would indicate that they are not the morphological equivalent of IIBr series of 4(3+4). These latter are not known to occur in *Stenometra*, or in any of the closely related genera. The occurrence of IIBr series of four ossicles of which the two outermost are not united by syzygy is not infrequent in comatulids in which the division series are normally 2. I once described under the name of *Cyllometra anomala* (see Part 4b, p. 145) a specimen of *C. manca* in which six of the seven IIBr series present are of four elements.

In 1911 I described a new species, *Stenometra cristata*, from *Albatross* station 5275, saying that it is nearest *S. diadema* from southern Japan, but is a smaller and more slender form; the centrodorsal is proportionately smaller, more conical and less columnar, with a finely papillose rounded conical tip; the cirri are about 40 mm. long; the longest cirrus segment, the fifth or sixth, is twice as long as broad or even somewhat longer instead of being but little longer than broad as in *S. diadema*; the carination of the division series and lower brachials is not quite so high as in *S. diadema*, and is more regular with a more even profile; the profile is irregular and serrate in *S. diadema;* the type specimen has 20 arms 85 mm. long. Four smaller specimens with 18, 17, 14, and 13 arms, the last two being immature, were secured at the same station. I cannot see that this supposed new species differs in any essential feature from *S. quinquecostata*.

Localities.—*Albatross* station 5275; China Sea, in the vicinity of southern Luzon; Malavatuan Island (N.) bearing S. 71° E., 10.75 miles distant (lat. 13°55′55″ N., long. 120°10′15″ E.); 214 meters; fine sand; July 16, 1908 [A. H. Clark, 1911, 1912, 1918] (6, U.S.N.M., 27501 [type specimen], 35598).

Menado Bay, northern Celebes (lat. 1°31′ N., long. 124°47′ E.); 457 meters; Captain Christiansen, Great Northern Telegraph Company, March 12, 1912 (18, U.S.N.M., E. 3215; C. M.).

Albatross station 5617; Moluccas; Ternate Island (S. E.) bearing S. 45° W., 7 miles distant (lat. 0°49′30″ N., long. 127°25′30″ E.); 239 meters; Nov. 27, 1909 (1, U.S.N.M., 36030).

Challenger station 192; near the Kei Islands (lat. 5°49′15″ S., long. 132°14′15″ E.); 256 meters; blue mud; September 26, 1874 [P. H. Carpenter, 1888; Hartlaub, 1891, 1912; A. H. Clark, 1907, 1909, 1911, 1912, 1913, 1918; Gislén, 1934] (3, B. M.).

Rotti Strait, between Timor and Rotti; 183 meters; from the Banjuwangi-Darwin No. 2 cable; cable repair ship *The Cable*, Eastern and Associated Telegraph Co. [A. H. Clark, 1929] (3, B. M.).

Geographical range.—From the Philippines to the Kei Islands and Timor.

Bathymetrical range.—From 183 to 457 meters.

History.—This species was first described under the name of *Antedon quinquecostata* by Dr. Philip Herbert Carpenter in 1888 from eight specimens and two fragments that had been dredged by the *Challenger* at station 192. Carpenter discussed the species at considerable length comparing it especially with *A.* (*Stylometra*) *spinifera*, and also with *A.* (*Aglaometra*) *valida*. He dissected one of the specimens and described and figured the central calcareous structures in detail.

In 1891 Dr. Clemens Hartlaub compared *Antedon quinquecostata* in some detail with his new species *A.* (*Cosmiometra*) *conifera*. In 1907 I referred *quinquecostata* to the new genus *Thalassometra*, and in 1909 I described the new genus *Stenometra* with *Antedon quinquecostata* as the genotype. Later in the same year in discussing the new species *Stenometra dorsata* (=*diadema*) I wrote:

> At first I considered this species the same as the earlier *quinquecostata* of Carpenter; but it is certainly true that the number of cirrus joints in Japanese specimens is considerably less than in those from the Ki Islands, and, as this appears to be perfectly constant, there seems to be no doubt that I was in error, and that the two are in reality perfectly distinct. This form appeared to me to be covered by the name *conifera* of Hartlaub; but a personal examination of the unique type of that species, which is in the Berlin Museum, showed me that *conifera* is in reality a species of *Cosmiometra*, allied to *C. crassicirra* of Hawaii.

In 1911 I described *Stenometra cristata* from five specimens from *Albatross* station 5275, comparing it with *S. dorsata* (=*diadema*) from southern Japan. There can be little doubt that *S. cristata* is based upon individuals of *S. quinquecostata* that have not attained their full development. At the same time I noted that *S. quinquecostata* resembles *S. dorsata* (=*diadema*) in having short cirrus segments, but it differs in having a considerably larger number. Further information has proved this statement incorrect.

In 1912 Hartlaub compared *Antedon quinquecostata* in detail with *A.* (*Stylometra*) *spinifera*. His information regarding *quinquecostata* was taken from Carpenter's account in the *Challenger* report, but he had before him many specimens of *spinifera*. In my memoir on the crinoids of the Indian Ocean published later in 1912 I listed *Stenometra quinquecostata* and gave the range.

In a memoir on the crinoids of the British Museum published in 1913 I gave notes on three specimens from *Challenger* station 192 that I had examined in 1910. In my report on the unstalked crinoids of the *Siboga* expedition published in 1918 *quinquecostata* was included in a key to the species of *Stenometra,* and the range and synonymy were given. In 1929 I recorded and gave notes on two specimens that had been found on a cable in Rotti Strait in 100 fathoms by the Eastern and Associated Telegraph Company's cable repair ship *The Cable.* At the same time I described in detail under the name of *Stenometra diplax* another specimen from the same locality which is undoubtedly merely an aberrant individual of *S. quinquecostata.* In 1934 when recording a number of species in the Raffles Museum, Singapore, collected by the cable repair ship *The Cable,* I mentioned *Stenometra diplax* as one of the new species that had been collected by that ship in previous years.

In 1934 Prof. Torsten Gislén discussed the arm division of *Stenometra quinquecostata* which he placed in his type 42, the *Stephanometra spicata* type.

STENOMETRA DIADEMA (A. H. Clark)

Plate 2, Figure 5

[See also vol. 1, pt. 1, figs. 191, 192, p. 237; pt. 2, fig. 211, p. 152.]

Antedon quinquecostata A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 129 (comparison, in key, with *A. diadema*), p. 143 (comparison with *A.* [*Parametra*] *orion*), p. 145 (comparison with *A.* [*Cosmiometra*] *aster;* considered as including *A.* [*Cosmiometra*] *conifera*).

Antedon diadema A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 144 (description; *Albatross* station 4934); vol. 34, 1908, p. 468 (listed).

Thalassometra quinquecostata A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (in part; listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 310 (various localities in Sagami Bay).

Thalassometra diadema A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 318 (Japan).

Stenometra diadema A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 15 (listed); Crinoids of the Indian Ocean, 1912, p. 210 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 156 (in key; range); p. 157 (synonymy).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 118 (compared with *S. dentata*); Zool. Bidrag Uppsala, vol. 9, 1924, p. 44; Vid. Medd. Dansk Naturh. Foren. København, vol. 83, 1927, p. 3 (stations 7, 9; 162–198 meters), p. 39 (stations 7, 9; notes), p. 68 (listed), figs. 34, 35, p. 44; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.—A. H. Clark, Temminckia, vol. 1, 1936, p. 315.

Stenometra quinquecostata (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 15 (listed).

Stenometra dorsata A. H. Clark, Vid. Medd. Naturh. Foren. København, 1909, p. 186 (description; near Nagasaki, 170 fathoms; "Eastern Asia"; compared with *S. quinquecostata* and with *Cosmiometra conifera*); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 553 (compared with *S. cristata*); Crinoids of the Indian Ocean, 1912, p. 123 (parasitic *Eulima*), p. 210 (synonymy; locality); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 179 (range in eastern Asia); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance); Die Crinoïden der Antarktis, 1915, p. 125 (shows characteristic features of *Anthometra adriani*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 157 (identity).

Diagnostic features.—The elements of the division series and first two brachials have the proximal and distal edges unmodified and the lateral borders smooth or practically so; and the crest in profile is coarsely denticulate, on the IBr_1 usually deeply bilobate. The 15–20 (almost always 20) arms are 65–80 mm. long, and the longest cirri are 38–50 mm. long with 55–78 segments.

Description.—The type series was composed of small individuals which were thus described. The centrodorsal is long and columnar, with the tip conical. The cirrus sockets are arranged in 10 columns of 2 each, the sockets of one column alternating with those of the adjoining columns.

The cirri are XX, 50–55, 25 mm. long. The segments in the basal half, except for the proximal, are elongate, those in the distal half short with prominent dorsal spines.

The basals are just visible as small interradial tubercles.

The radials are rather long. The IBr_1 are about the size of the radials, and the IBr_2 (axillaries) are widely pentagonal, broader than long; both have a high and sharp median keel. The IIBr series are 2, like the IBr series and with a prominent keel.

The 11–18 arms are 30 mm. long (only one-fifth longer than the cirri). The first 8 brachials are oblong, rather long, those following becoming wedge-shaped. All the brachials are strongly carinate and laterally compressed. After the basal third the arms become very narrow and the brachials begin to develop overlapping dorsal spines.

P_1 is considerably the largest pinnule and is composed of 8–10 elongated segments. The pinnules following decrease in length to P_5 or P_6, then slowly increase in length distally.

The color in life is bright yellow.

In fully grown individuals the arms are 19–20 (usually 20), about 80 mm. long; the cirri are composed of about 70 segments and are 45–50 mm. long.

Notes.—In a specimen from Mortensen's station 7, according to Gislén, the centrodorsal is a high cone 2.8 mm. broad at the base and 2.6 mm. high. The bare dorsal pole is 2.4 mm. in diameter and is covered with pits and tubercles. There are 5 strong interradial ridges. The cirrus sockets are arranged in 10 columns of 2 or 3 each. There is a tubercle on each side of the nerve lumen.

The cirri are XXIII, 57–78, 25–45 mm. long. The sixth-seventeenth cirrus segments are slightly longer than broad. Dorsal spines are developed from the fifteenth onward.

The radials are visible in the interradial angles of the calyx. The IBr_1 are five times as broad as long with an abrupt high bidentate crest in the median line. The IBr_2 (axillaries) are twice as broad as long with a median sharp and simple crest in the proximal three-fourths, and a synarthrial backward projection. The IIBr series are 2 with a carination similar to that of the IBr series but lower and not serrate.

The 20 arms are all broken. The carination continues to the ends of the arms. Overlapping dorsal spines are developed from the fifth brachial onward.

The distal intersyzygial interval is 5–7 muscular articulations.

P_1 is 11 mm. long with 19–20 segments. P_2 is 8 mm. long with 13 segments. P_3 is 7.5 mm. long with 12 segments. P_4 is 4.5 mm. long with 8 segments. P_5 is 3.7 mm. long with 7 segments. The distal pinnules are 7 mm. long with 16 segments.

The disk is 7.5 mm. in diameter with sparse calcareous granules along the ambulacral furrows. The anal cone is 2 mm. high and bears granules.

The color in alcohol is brown, the ossicles somewhat brighter.

Another specimen from Mortensen's station 7 has the cirri XIX, 59–77, 26–38 mm. long. The 20 arms are 65 mm. long. P_1 is 6.2 mm. long with 11 segments.

P_2 is 4.7 mm. long with 8 segments. P_3 is 3 mm. long with 7 segments. P_4 has 6 and P_5 has 7 segments. The distal pinnules are 5.5 mm. long with 14 segments.

A third specimen from Mortensen's station 7 has the cirri XXI, 44–61, 22–31 mm. long; the longest cirrus segments is one-third again as long as broad. The 15 arms are 70 mm. long. P_1 has 11 segments, P_2 has 8 segments, and P_3 has 6 segments. The distal pinnules are about 5 mm. long with 10–12 segments.

A specimen from Mortensen's station 9, according to Gislén, has the cirri about XX, 58, 28 mm. long. The 15 arms are all broken. The proximal crest is tolerably even with notches only at the articulations. P_1 is 5.5 mm. long with 11 segments. The disk is incised, 3.5–4.5 mm. in diameter. The anal cone is 1.5 mm. high.

Two dried 10-armed young from Mortensen's station 9 have the arms about 30 mm. long; one cirrus in the smaller specimen is 17 mm. long with 44 segments.

Professor Gislén wrote that the appearance of the cirrus sockets is interesting as it presents similarity with those of certain cretaceous comatulids in the families Notocrinidae and Conometridae, and the *Essenensis* and *Paradoxus* groups of *Glenotremites*.

The specimens from Sagami Bay collected by Alan Owston are yellow with a broad line on the division series and arms and a lateral line on the arms white; the cirri are banded yellow and white, and the pinnules are blotched yellow and white.

One of the specimens from *Albatross* station 3719 has 20 arms 80 mm. long and the cirri 45 mm. long.

Parasite.—Professor Gislén noted that a specimen from Mortensen's station 7 was infested with a parasitic gastropod of the genus *Eulima* (see Part 2, page 649, *Melanella* sp.).

Localities.—Sagami Bay, Japan (lat. 35°04′ N., long. 138°48′ E.); 146 meters; Alan Owston, yacht *Golden Hind,* August 8, 1902 [A. H. Clark, 1908] (1, U.S.N.M., 35616 [original No. 7196]).

Sagami Bay (lat. 35°03′ N., long. 138°47′ E.); 201 meters; Alan Owston, yacht *Golden Hind* [A. H. Clark, 1908] (1, U.S.N.M., 35615 [original No. 7189]).

Sagami Bay; off Yenoshima; Alan Owston, yacht *Golden Hind,* April 1896 [A. H. Clark, 1908] (1, U.S.N.M., 35600 [original No. 6275]).

Albatross station 3719; off Honshu Island, Japan; Ose Zaki bearing S. 13° W., 1.5 miles distant; 128–165 meters; volcanic sand, shells, and rock (3, M. C. Z., 64, 300).

Albatross station 3755; off Honshu Island, Japan; Suno Saki bearing S. 63° E., 3.6 miles distant; 95–141 meters; gray sand and coral; May 19, 1900 (1, U.S.N.M., 35610).

Albatross station 4936; Eastern Sea, off Kagoshima Gulf; Sata Misaki Light bearing N. 21° E., 5.7 miles distant (lat. 30°54′40″ N., long. 130°37′30″ E.); 188 meters; stones; bottom temperature 15.9° C.; August 16, 1906 (1, U.S.N.M., 35611).

Albatross station 4934; Eastern Sea, off Kagoshima Gulf; Sata Misaki Light bearing N. 77.5° E., 7 miles distant (lat. 30°58′30″ N., long. 130°32′00″ E.); 188–288 meters; rocky bottom; bottom temperature 13.3° C.; Aug. 16, 1906 [A. H. Clark, 1907] (3, U.S.N.M., 22637 [type of *Antedon diadema*], 35599).

Eastern Sea, near Nagasaki (lat. 32°22′ N., long. 128°42′ E.); 311 meters; Captain Suensson, November 23, 1901 [A. H. Clark, 1909] (2, C. M.).

Albatross station 4890; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki Light bearing N. 2° W., 10 miles distant (lat. 32°26′30″ N., long. 128°36′31″E.); 247 meters; rocky bottom; bottom temperature 11.3° C.; August 9, 1906 (1, U.S.N.M., 35614).

Albatross station 4900; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki Light bearing N. 10° E., 8 miles distant (lat. 32°28′50″ N., long. 128°34′40″ E.); 254 meters; gray sand and broken shells; bottom temperature 11.6° C.; August 10, 1906 (1, U.S.N.M., 35613).

Albatross station 4893; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki Light bearing N. 29° E., 5.5 miles distant (lat. 32°32′00″ N., long. 128°32′50″ E.); 174–194 meters; gray sand, broken shells, and pebbles; bottom temperature 13.3° C.; August 9, 1906 (1, U.S.N.M., 35612).

Dr. Th. Mortensen's Pacific Expedition station 9; off Kiu Shiu, Japan (lat. 32°15′ N., long. 128°12′ E.); 165 meters; hard bottom; May 15, 1914 [Gislén, 1922, 1924, 1927, 1934].

Dr. Th. Mortensen's Pacific Expedition station 7; off Kiu Shiu, Japan (lat. 32°17′ N., long. 128°11′ E.); 201 meters; sand; May 14, 1914 [Gislén, 1922, 1924, 1927, 1934].

Eastern Asia; Captain Suensson, July 29, 1900 [A. H. Clark, 1909, 1913] (1, C.M.).

Geographical range.—Southern Japan from the Korean Straits to Sagami Bay.

Bathymetrical range.—From 141 (?95) to 311 meters; the average of 11 records is 199 meters.

Thermal range.—From 11.3° to 15.9° C.

History.—During the cruise of the United States Fisheries steamer *Albatross* in Japanese waters in 1906 I collected a number of specimens of this species at five different stations in the Eastern Sea. These I identified with Carpenter's *Antedon quinquecostata,* except for three small individuals from station 4934 which I described as a new species under the name of *Antedon diadema* in 1907. In the same paper I inserted *Antedon quinquecostata* in a key to the new species described for comparison with *A. diadema.* The two species were said to be differentiated by the occurrence of 70–90 slender cirrus segments in *quinquecostata,* whereas *diadema* has only 50–55 stout cirrus segments. *Antedon quinquecostata* was compared with *A.* (*Parametra*) *orion,* sp. nov., and with *A.* (*Cosmiometra*) *aster,* sp. nov., with which species it has very little in common. I placed Hartlaub's *Antedon conifera* in the synonymy of *A. quinquecostata,* a proceeding that now appears wholly illogical. Later in 1907 I referred *diadema* and *quinquecostata* to my new genus *Thalassometra.*

In 1908 I recorded *Thalassometra quinquecostata* from three localities in Sagami Bay where it had been dredged by Alan Owston in his yacht the *Golden Hind.* When in Yokohama I had met Mr. Owston, and he had shown me his fine collection of Japanese crinoids. Later this collection was purchased by Frank Springer and deposited in the United States National Museum.

In January 1909, I established the new genus *Stenometra* to which I referred *diadema* and *quinquecostata,* the latter including the specimens from southern Japan. The genotype was given as *Antedon quinquecostata* P. H. Carpenter, 1888, but my idea of this species was based entirely upon Japanese specimens.

Dr. Theodor Mortensen, of the Zoological Museum, Copenhagen, Denmark, kindly sent me for study the entire comatulid collection of that Museum. In the collection were three specimens of the species I had identified as *Antedon quinquecostata* that had been collected off southwestern Japan by one of the Danish cable repair ships under the command of Captain Suensson. These agreed with the specimens I had collected in the same region and differed slightly, though apparently constantly, from *Antedon quinquecostata* as described by Carpenter in the *Challenger* report. For the species represented I proposed the name *Stenometra dorsata*, saying:

> I at first considered this species the same as the earlier *quinquecostata* of Carpenter; but it is certainly true that the number of cirrus joints in Japanese specimens is considerably less than in those from the Ki Islands, and, as this appears to be perfectly constant, there seems to be no doubt that I was in error, and that the two are in reality perfectly distinct. This form appeared to me to be covered by the name *conifera* of Hartlaub; but a personal examination of the unique type of that species, which is in the Berlin Museum, showed me that *conifera* is in reality a species of *Cosmiometra*, allied to *C. crassicirra* of Hawaii.

In 1911 I described a new species, *Stenometra cristata*, from the Philippines, comparing it with *S. dorsata*. I noted that in *S. dorsata* the carination of the division series and lower brachials is irregular and serrate in profile, and that *S. quinquecostata* resembles *S. dorsata* in having short cirrus segments, though it differs in having a considerably larger number. In my memoir on the crinoids of the Indian Ocean published in 1912 I listed both *Stenometra dorsata* and *S. diadema*, giving the synonymy and range of each. In a paper on the comatulid fauna of eastern Asia based chiefly upon the collections of Captain Suensson, in charge of one of the Danish cable repair ships, published in 1913, I listed *Stenometra dorsata* as from "East Asia (probably the Korean Straits)." This is a repetition of the record published in 1909. In 1915 in a paper on the bathymetrical and thermal distribution of the unstalked crinoids or comatulids occurring on the coasts of China and Japan the bathymetrical range of *Stenometra dorsata* was given as 52–170 fathoms, and the thermal range as from 11.28° to 15.89° C. Although it is not so stated, *S. dorsata* was regarded as including *diadema*. In my memoir on the crinoids of the Antarctic published in 1915 I pointed out that the characteristic features of *Anthometra adriani* of the subfamily Heliometrinae, family Antedonidae, are well developed in various other types, among them *Stenometra dorsata* and related species. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *diadema* was included in the key to the species of *Stenometra*, and its range was given as southern Japan in 91–306 meters. Under *Stenometra diadema* were listed the records of *Thalassometra quinquecostata* from southern Japan published in 1908, and *Stenometra dorsata* was included in *diadema* as a synonym.

In 1922 Prof. Torsten Gislén compared *Stenometra diadema* with his new species *S. dentata* from the Bonin Islands, and in 1924 he called attention to the reversion phenomenon as illustrated by *S. diadema*, of which he had before him some unrecorded specimens that had been collected by Dr. Theodor Mortensen off southwestern Japan. In 1927 he recorded and gave notes on three specimens from Dr. Mortensen's Pacific Expedition station 7, and three, including two 10-armed young, from station 9. In 1934 he discussed the arm division of *Stenometra diadema* which he placed in Type 21, the *Stenometra diadema* type. The specimens he had before him were some in the Lund Museum received from Dr. Mortensen.

In 1936 I compared *Stenometra diadema* with a new species, *S. snelliusi*, from Ceram.

Genus DAIDALOMETRA A. H. Clark

Antedon (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 137.
Thalassometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360.
Stenometra (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 15.
Stiremetra (part) A. H. Clark, Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, pp. 440, 443.
Daidalometra A. H. Clark, Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (no diagnosis; name used in combination with [*Antedon*] *hana*); vol. 6, No. 5, 1916, p. 116 (diagnosis; genotype *Antedon hana* A. H. Clark, 1907; comparison of arms with those of *Stenometra*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 146 (in key; range), p. 147 (same), p. 157 (key to the included species).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 9, 118; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20.

Diagnosis.—A genus of Thalassometridae in which the division series, which are all 2, and arms are laterally compressed and sharply carinate, gablelike in cross section, the brachial carination being produced into high crests or broad overlapping spines; the arms in fully developed individuals are 10–18 (usually 10–15) in number, 60–65 mm. long; P_1 resembles P_2 but is somewhat longer and proportionately stouter; the cirri are long, slender, and delicate, 20–24 mm. long with 32–75 segments, and are arranged in 10 columns on a small conical or truncated conical centrodorsal.

Geographical range.—From Port Denison, Queensland, to Timor and northward to southwestern Japan.

Bathymetrical range.—From 22 to 548 meters.

Remarks.—The genus *Daidalometra* is very closely related to *Stenometra* and perhaps should not be separated from it. There appear to be no real differences between the two other than in the number of arms, and in this feature there is a certain amount of overlapping between occasional individuals of some species. The three species of *Daidalometra* appear to be well characterized, although all three are known from only a small number of individuals.

History.—The genus *Daidaometra* was established in 1916 with the genotype *Antedon hana* A. H. Clark, 1907. The two species included in it at the time of the original description were *D. hana* and *D. acuta*. In 1918 a key to the two included species was given, with *acuta* regarded as a synonym of the earlier *arachnoides*.

In 1922 in his description of *Stenometra dentata* Prof. Torsten Gislén wrote that this new species approaches *Daidalometra* (*hana*), a genus properly distinguished from *Stenometra* only by a smaller number of arms. He said that *S. dentata* is to a certain extent a transition between these two genera.

KEY TO THE SPECIES IN THE GENUS DAIDALOMETRA

*a*¹. Cirri short, not more than half the length of the arms, with not more than 65 segments; arms 60–65 mm. long.
  *b*¹. Cirri with 49–65 segments; division series and proximal brachials with a narrow, sharp, and high median carination, the ossicles with everted and spinous edges; 10–18 (usually 10–13) arms (Queensland to Timor and northward to the Sulu [Joló] Archipelago; 22–118 meters). **arachnoides** (p. 25)
  *b*². Cirri with 32–39 segments; carination of the division series and arm bases low with a rounded crest; edges of the elements of the division series and proximal brachials little modified; 10 arms (Zamboanga, Mindanao; about 548 meters)---------------------**eurymedon** (p. 24)
*a*². Cirri longer, more than two-thirds of the length of the arms, 40–45 mm. long with 68–77 segments; arms 10–11, 60 mm. long (southwestern Japan; 196–254 meters)-----------**hana** (p. 27)

DAIDALOMETRA EURYMEDON, sp. nov.

Diagnostic features.—The cirri are short, considerably less than half the length of the arms, with 32–39 segments; the carination of the division series and arm bases is low, with a rounded crest; and the proximal and distal borders and the lateral edges of the elements of the division series and first two brachials are sparsely spinous or tubercular. The 10 arms are about 65 mm. long, and the cirri are up to 24 mm. long.

Description.—The centrodorsal is conical, with the truncated apex bearing in the center a group of six long blunt spines, of which one is centrally situated and the other five are radially placed about it. The cirrus sockets are arranged in 10 columns of usually 2 each. The two columns in each radial area are more or less separated proximally in the midradial line, but are in contact apically. The columns are everywhere closely crowded against each other interradially.

The cirri are XX, 32–39, up to 24 mm. in length. The first segment is very short, the second is longer, the third is from twice as broad as long to slightly longer than broad. In the longest cirri the fourth segment is as long as, or slightly longer than, broad, and the fifth is a transition segment, from two and one-half to three times as long as the median width. The segment following is of about the same length, slightly longer or slightly shorter, and those succeeding decrease in length so that the segments in the outer half of the cirri are about as long as broad, becoming more or less longer than broad distally. In the shorter cirri the fourth is the transition segment. The midventral line of the first four segments and of the proximal portion of the transition segment is more or less narrowly gabled, though never sharply carinate. The distal dorsal edge of the transition segment is slightly produced. This production of the dorsal portion of the distal edge slowly increases in amount, and in the outer quarter of the cirri becomes a high carinate dorsal spine.

The radials are rather long, being about three times as broad as the median length. The distal border is everted and more or less irregular, and there is a high and abrupt narrowly rounded median keel or tubercle. The IBr_1 are about four times as broad as the median length. The lateral borders are in contact, and the anterolateral angles are sharply cut away. The median portion rises into a sharply rounded median carination which is very distinct, though much lower than that on the radials, and the lateral portions of the distal border bear usually two conspicuous short blunt spines or tubercles. The IBr_2 (axillaries) are rhombic, nearly twice as broad as long, with a prominent thin lateral flange under each of the lateral angles, a roundedly carinate elevation in the proximal half or two-thirds corresponding to that on the IBr_1, and a few blunt spines or tubercles on the proximal border just above those on the distal border of the IBr_1.

The 10 arms are about 65 mm. long. The first two brachials bear a narrow flange on the outer side by which they are just in contact. The first brachials may have minute denticulations on the distal border. The earlier brachials are rather abruptly rounded in the middorsal line, this feature being most marked on the first two; but they can scarcely be called carinate. The brachials in the outer half of the arm have the median portion of the distal edge greatly produced and tipped with a comb of spines, so that the dorsal profile of the outer half of the arms is very strongly serrate.

P_1 is much enlarged, and is much larger than the pinnules succeeding. It is composed of 12 segments of which the third is greatly broadened. From this it tapers to the base, and also distally, the terminal five segments being exceedingly small.

Notes.—The second specimen resembles that described, except that the spinosity of the dorsal pole of the centrodorsal is much less developed; there are 32–34 cirrus segments.

These specimens are evidently young, and the characteristic features of the species have not as yet become fully accentuated.

Locality.—Dr. Th. Mortensen's Pacific expedition, 1914–1916; 7 miles south of Olutanga Island, east of Zamboanga, Mindanao, Philippine Islands; about 548 meters; hard bottom; March 3, 1914 (2, C. M.).

DAIDALOMETRA ARACHNOIDES (A. H. Clark)

PLATE 3, FIGURE 12

[See also vol. 1, pt. 1, fig. 205, p. 239; pt. 2, fig. 744, p. 349.]

Stenometra arachnoides A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 402 (description; *Albatross* station 5154; ?Port Denison, Queensland).

Stiremetra arachnoides A. H. CLARK, Die Fauna Südwest-Australiens, vol. 3, Lief. 13, 1911, p. 440 (range), p. 443 (range on east coast); Mem. Australian Mus., vol. 4, 1911, p. 721 (south to Port Denison), p. 789 (synonymy; history; range); Crinoids of the Indian Ocean, 1912, p. 213 (synonymy; localities); Internat. Rev. gesamt. Hydrobiol. Hydrogr., 1915, p. 223 and following (distribution in Australia).

Stenometra acuta A. H. CLARK, Zool. Anz., vol. 39, No. 11/12, 1912, p. 428 (description; *Siboga* station 294); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 157 (identity).

Daidalometra acuta A. H. CLARK, Journ. Washington Acad. Sci., vol. 6, No. 5, 1916, p. 116 (range).

Daidalometra arachnoides A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 157 (in key range; synonymy; notes; stations 166, 294), pp. 273, 275 (listed), pl. 23, fig. 60.

Diagnostic features.—The cirri are short, not more than half the arm length, with 49–65 segments; and the elements of the division series and first two brachials have a narrow, sharp, and moderately high median carination and abruptly everted and coarsely spinous edges. The 10–18 (usually 10–13 and most commonly 10) arms are 60 mm. long, and the cirri are 20–30 mm. long

Description.—The centrodorsal is moderate in size, columnar, broader basally than long, decreasing slightly in width distally. The bare polar area is 2 mm. in diameter. The cirrus sockets are arranged in 10 closely crowded columns of 2 each.

Cirri XX (XII in the type), 61–65, 30 mm. long. The first 4 segments are subequal, averaging twice as broad as long, rather prominently overlapping all around. The fifth segment is nearly half again as long as broad, a more or less marked transition segment. The sixth is of about the same length or slightly shorter. The next 5 segments are about as long as broad, and those succeeding gradually decrease in length so that those in the distal half of the cirri are twice as broad as long or even slightly shorter. The fourteenth or fifteenth and following segments bear prominent dorsal spines.

The disk and ambulacra are well plated.

The ends of the basal rays are visible as dorsoventrally elongate tubercles in the interradial angles of the calyx.

The radials are entirely concealed by the centrodorsal, or their distal coarsely spinous borders are just visible over the ends of the basal rays. The IBr_1 are very narrow, chevron-shaped, with abruptly everted and coarsely spinous edges; they are in close lateral apposition. The IBr_2 (axillaries) are rhombic, twice as broad as long, with the edges concave, and abruptly everted and coarsely spinous all around. There is a high and sharp median keel in the proximal two-thirds.

The 10 arms are all broken off at the base. The first 2 brachials externally and the second and third internally are sharply flattened laterally. The first brachials are interiorly united. The second brachials are large, shield-shaped, deeply incising the very narrow first brachials. The first 2 brachials have more or less everted and coarsely spinous edges. The arms have a very narrow, sharp, and moderately high median carination.

The pinnules resemble essentially those of *S. hana.*

Notes.—Of the four specimens from *Siboga* station 166 one has 10 arms and cirri with 54 segments; another has 13 arms about 60 mm. long and cirri with 49–54 segments, 20–25 mm. long; the other two have 16 and 18 arms.

The specimen from the Danish Expedition to the Kei Islands station 24 has the cirri XIX, 57–61, about 30 mm. long; there are 13 arms, all broken. The division series and arms have a low and very narrow, though prominent, median keel.

In my diagnosis of *Stenometra acuta* from *Siboga* station 294 I said that this species is most closely related to *S. hana* of Japan, but it is at once distinguishable from that form by the much shorter cirri which have fewer segments; the carination of the proximal brachials is somewhat sharper and more prominent than in *S. hana.* The type specimen has the cirri XII, 51–58, 25 mm. long; the first three segments (sometimes also the fourth) bear dorsally a fine median carination ending distally in a small spine as in *S. hana.* The 12 arms are about 60 mm. long. The other specimens from *Siboga* station 294 are all small with 10 arms.

Localities.—*Albatross* station 5154; Tawi Tawi Group, Sulu (Joló) Archipelago; Bakun Point bearing S. 11° W., 0.7 mile distant (lat. 5°14′50″ N., long. 119°58′45″ E.); 22 meters; coral sand; February 19, 1908 [A. H. Clark, 1909, 1912, 1918] (1, U.S.N.M., 25470).

Siboga station 166; Ceram Sea (lat. 2°28′30″ S., long. 131°03′18″ E.); 118 meters; hard coarse sand; August 22, 1899 [A. H. Clark, 1918] (4, U.S.N.M., E. 413; Amsterdam Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 24; Kei Islands; 100 meters; April 15, 1922 (1, C. M.).

Siboga station 294; Timor Sea (lat. 10°12′12″ S., long. 124°27′18″ E.); 73 meters; soft mud with very fine sand; January 23, 1900 [A. H. Clark, 1912, 1918] (6, Amsterdam Mus.).

Port Denison, Queensland [A. H. Clark, 1909, 1911, 1912, 1918] (1, U.S.N.M., 17862).

Geographical range.—From the Sulu (Joló) Archipelago southward to the Ceram and Timor Seas and Port Denison, Queensland.

Bathymetrical range.—From 22 to 118 meters.

History.—This species was originally described in 1909 under the name of *Stenometra arachnoides* from a specimen from *Albatross* station 5154. At the same time I noted that:

> A much mutilated specimen found in a jar with a specimen of *Amphimetra discoidea* (and therefore probably taken in shallow water), from Port Denison, Australia, certainly belongs to this genus, and possibly to this species. It is slightly smaller than the type, with the keels less produced, and with the spinous edges of the lower joints less pronounced, differences which are in all probability due to immaturity.

I remarked that the occurrence in the East Indian region of a littoral species of Thalassometridae, a family there and elsewhere especially characteristic of the deep water "Oceanic" faunal division is a fact of very considerable interest. In a memoir on the recent crinoids of Australia published in 1911 I noted that a specimen of *Stiremetra arachnoides* was found in the jar containing the type specimen of *Amphimetra discoidea.* The United States National Museum had received these crinoids many years before in exchange from the Australian Museum. They were collected at Port Denison. In my report on the crinoids collected by the Hamburg Southwest Australian Expedition in 1905, which was published in 1911, I listed *Stiremetra arachnoides* and gave the range. In my memoir on the crinoids of the Indian Ocean published in 1912 *Stiremetra arachnoides* was included, and the synonymy and range were given. In 1912 I gave a brief diagnosis of a new species, *Stenometra acuta*, from *Siboga* station 294. In 1915 I again gave the range of *Stiremetra arachnoides.* In 1916 I described the new genus *Daidalometra* and listed *Daidalometra arachnoides* as one of the two included species. In my report upon the unstalked crinoids of the *Siboga* Expedition published in 1918 I recorded four specimens of *Daidalometra arachnoides* from station 166 and six specimens from station 294. Under *Daidalometra arachnoides* I included *Stenometra acuta*, originally described from a specimen from station 294, as a synonym.

DAIDALOMETRA HANA (A. H. Clark)

PLATE 4, FIGURE 13

[See also vol. 1, pt. 1, fig. 212, p. 153.]

Antedon hana A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 137 (description; *Albatross* station 4903).

Thalassometra hana A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 318 (Japan).

Stenometra hana A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 15 (listed); Zool. Anz., vol. 39, No. 11/12, 1912, p. 428 (compared with *S. acuta* [*Daidalometra arachnoides*]); Crinoids of the Indian Ocean, 1912, p. 210 (synonymy; locality).

Daidalometra hana A. H. CLARK, Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance); vol. 6, No. 5, 1916, p. 116 (range); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 157 (in key; range; references).—GISLÉN, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 118 (compared with *Stenometra dentata*).

Diagnostic features.—The cirri are slender and long, more than two-thirds the arm length, with 68–77 segments; and the elements of the division series and first two brachials have a rather low and strongly rounded median carination and their borders are little or not at all modified. The 10–11 (usually 10) arms are 60 mm. long, and the cirri are 40–45 mm. long.

Description.—The centrodorsal is low hemispherical or rounded discoidal with the apical area spinous, bearing 10 columns of cirrus sockets, 2 to each column.

The cirri are XX, 65–75, from 40 mm. to 45 mm. in length. The first 4 or 5 segments are very short, and those following are longer than broad, the seventh-ninth, which are the longest, being somewhat less than twice as long as broad. The succeeding segments gradually become shorter, about as long as broad just beyond the middle of the cirrus and very short distally. Dorsal spines are developed in the distal third of the cirri.

The disk, and the brachial and pinnule ambulacra are well plated.

The ends of the basal rays are visible as small tubercles in the angles of the calyx.

The radials are very short, crescentic, and are furnished with a fringe of spines along the superior border. The IBr_1 are very short, deeply incised by the axillaries, and are furnished with a fringe of teeth about their entire edge. The IBr_2 (axillaries) are rhombic, about twice as broad as long, with the sides slightly incurved and with a strong rounded median keel in the proximal half which continues into a similar keel on the first brachials.

Arms 10–11 (in all but one case 10) in number, 60 mm. long. The first 8 brachials are roughly oblong with irregular lateral dentate processes and a faintly marked median keel which is most prominent on the first and second. The following brachials are wedge-shaped becoming gradually shorter and more compressed laterally and developing a sharp median keel and long median overlapping spines. The terminal brachials become longer again. The elements of the division series and the first 4 brachials are sharply flattened laterally and are in close lateral apposition.

P_1 is the longest, about 5 mm. in length, very stout, composed of 8–10 segments of which the basal 5 are large, massive, and about as long as broad and the remainder are small and rapidly diminish in size. This pinnule is very sharply prismatic and strongly flattened exteriorly; its distal border is furnished with a strong lateral ridge on either side having a more or less deep groove between. The following pinnules decrease in length to P_5 which is 3.5 mm. long with the first segment large and about as long as broad and the remainder tapering rapidly to a point, then gradually increase distally becoming rather slender and reaching a length of about 8 mm. with 15–18 segments of which the first 2 are enlarged and the remainder are somewhat longer than broad. All the pinnules are prismatic and strongly carinate.

Locality.—*Albatross* station 4903; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki Light bearing N. 22° E., 6 miles distant (lat. 32°31′ 10″N., long. 128°33′20″ E.); 196–254 meters; gray sand and broken shells; August 10, 1906 [A. H. Clark, 1907, 1908, 1909, 1912, 1915, 1918; Gislén, 1922] (5, U.S.N.M., 22632 [type], 35595).

History.—This species was described under the name of *Antedon hana* in 1907 from five specimens that had been dredged by the *Albatross* at station 4903 in the preceding year. Later in 1907 it was transferred to the new genus *Thalassometra*, and in 1908 it was listed from Japan as *Thalassometra hana*. In 1909 it was transferred to the new genus *Stenometra*, and in 1912 it was compared with the new species *Stenometra acuta* (=*Daidalometra arachnoides*). Later in 1912, in my memoir on the crinoids of the Indian Ocean, it was listed and the synonymy and range were given.

In 1915 the new genus *Daidalometra* was created for its reception, and in 1916 the range was again given. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 it was included in a key to the species of the genus *Daidalometra*, and was listed with its range and synonymy. In 1922 Prof. Torsten Gislén compared it with his new species *Stenometra dentata*.

Genus STYLOMETRA A. H. Clark

Antedon (part) P. H. Carpenter, Bull. Mus. Comp. Zool., vol. 9, No. 4, 1881, p. 158, and following authors.

Thalassometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360.

Stylometra A. H. Clark, Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 245 (characters; genotype *Antedon spinifera* P. H. Carpenter, 1881); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211 (referred to the Thalassometridae), p. 212 (occurs in the West Indies); Amer. Nat., vol. 42, No. 500, 1908, p. 542 (characteristic oceanic genus); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (same); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14 (listed, with its component species); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 10 (represents in the West Indies the East Indian *Cosmiometra*); Crinoids of the Indian Ocean, 1912, p. 13 (corresponds to the East Indian *Cosmiometra*); Internat. Rev. Gesamt. Hydrobiol. Hydrogr., 1914, pp. 4 and following (represents *Cosmiometra* in the Atlantic; range); Die Crinoïden der Antarktis, 1915, p. 181 (range; corresponds to the East Indian *Cosmiometra*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 147 (in key; range), p. 156; Univ. Iowa Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (confined to the West Indies), p. 19 (in key); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range), p. 51 (in key).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 74, 100.—Boone, Bull. Bingham Oceanographic Coll., vol. 1, art. 4, April 1928, p. 3.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934.

Diagnosis.—A genus of Thalassometridae in which the division series, which are all 2, and arm bases are rather strongly and evenly rounded dorsally, with the edges of the ossicles armed with numerous stout spines, which may occur on the dorsal surface also; and the brachials beyond the more or less oblong or quadrate proximal ones are strongly carinate, the carination taking the form of a long, broad, curved, overlapping spine. The 20–30 arms are 65–140 mm. long, and the slender cirri are 35–50 mm. long with 40–80 segments.

Geographical range.—From the Bahamas and Greater Antilles westward to Cozumel Island, off Yucatán, and eastward and southward along the Antillean chain to Grenada.

Bathymetrical range.—From 102 to 508 (?548) meters.

Thermal range.—From 8.33° to 23.6° C.

Remarks.—The genus *Stylometra* includes only a single species, *S. spinifera*. It is the somewhat modified Atlantic representative of the widespread Indo-Pacific genus *Cosmiometra*.

History.—The genus *Stylometra* was established in 1908 with the genotype *Antedon spinifera* P. H. Carpenter, 1881. In my first revision of the old genus *Antedon* published in 1907 *Antedon spinifera* had been referred to the genus *Thalassometra*. There has been no change in the status of the genus *Stylometra* since it was first established.

STYLOMETRA SPINIFERA (P. H. Carpenter)

Plate 3, Figure 8

[See also vol. 1, pt. 1, figs. 35, p. 73, 193, 194, p. 237, 273, p. 259, 368, p. 297, 484, p. 365; pt. 2, figs. 72, 73, p. 43, 124, p. 79, 219, p. 166, 318, p. 227, 337, p. 229, 521, 522, p. 283, 743, p. 349, pl. 53, fig. 1345.]

Antedon sp. P. H. Carpenter, Bull. Mus. Comp. Zool., vol. 9, No. 4, 1881, p. 158 (one of the two comatulids which appear from their abundance to be especially characteristic of the neighborhood of the Caribbean islands, ranging from Sta. Cruz to Grenada; brought back by Duchaissaing from Guadeloupe in 1870; obtained by the *Blake* at 10 stations in 80½–297 fathoms; most abundant at station 269 off St. Vincent in 124 fathoms; also dredged in 278 fathoms off St. Lucia by the *Investigator*).

Antedon spinifera P. H. Carpenter, Bull. Mus. Comp. Zool., vol. 9, No. 4, 1881, p. 158 (detailed description; ambulacral plating described), p. 162 (ambulacral plating).—Bell, Proc. Zool. Soc. London, 1882, p. 533 (listed), p. 534 (specific formula).—P. H. Carpenter, Proc. Zool. Soc. London, 1882 (1883), pp. 740, 746 (discussion of Bell's method of formulation and corrected formulae).—von Graff, Bull. Mus. Comp. Zool., vol. 11, No. 7, 1883, p. 129 (off Montserrat, 88 fms.; off St. Vincent, 124 fms.; myzostomes).—P. H. Carpenter, *Challenger* Reports, Zool., vol. 11, pt. 32, 1884, p. 277, footnote (arm division).—von Graff, *Challenger* Reports, Zool., vol. 10, pt. 27, 1884, pp. 14, 15, 19 (myzostomes), p. 44 (*Blake* sta. 157), p. 47 (*Blake* stas. 155, 269).—Lockington, Standard Nat. Hist., vol. 1, 1884, p. 143.—A. Agassiz, Bull. Mus. Comp. Zool., vol. 15, reprinted as "Three Cruises of the *Blake*," vol. 2, 1888, p. 125, fig. 417 (general account).—Braun, Centralbl. Bakteriol. und Parasitenkunde, vol. 3, 1888, p. 185 (myzostomes; after von Graff).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 50 (arm division), p. 55 (specific formula), pp. 208–211 (characters of the *Spinifera* group and key to the included species), p. 216 (compared with [*Stenometra*] *quinquecostata*), p. 217 (compared with [*Stiremetra*] *lusitanica*), p. 306 (very closely allied to *quinquecostata*), p. 368 (bathymetric range), p. 379 (Caribbean Is., 80–297 fms.); Journ. Linn. Soc. (Zool.), vol. 21, 1889, p. 306 (arm arrangement compared with that of *Antedon elegans* [=*Zygometra comata*]).—Minckert, Arch. Naturg., Jahrg. 71, 1905, vol. 1, pp. 170 and following (syzygies; regeneration).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 152 (comparison of brachials with those of *A.* [*Thalassometra*] *hawaiiensis*).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 280 (in the *Blake* collection), p. 309 (in the *Spinifera* group; history), pp. 358–366 (synonymy; St. Lucia, *Investigator; Blake* stas. 155, 220, 231, 232, 249, 259, 269, 290, 292, 297, 298, 299; detailed description and discussion), pl. 1, figs. 9, 12–16, 19, 20, pl. 2, figs. 1–12.

Thalassometra spinifera A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed).

Stylometra spinifera A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14 (listed); Bull. Mus. Hist. Nat. Paris, 1911, No. 4, p. 256 (notes on Duchaissaing's specimen); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 43 (Barbados); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 156 (references).—H. L. Clark, Bull. Lab. Nat. Hist., Univ. Iowa, vol. 7, No. 5. 1918, p. 10 (Bahamas Exped. station 2)—A. H. Clark, Univ. Iowa Studies in Nat. Hist., vol. 9, No. 5, 1921, pp. 10, 11 (occurrence at Barbados); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, pl. 15, fig. 53 (arm), fig. 54 (syzygial pairs); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 79.—Boone, Bull. Bingham Oceanographic Coll., vol. 1, art. 4, April 1928, p. 3 (*Pawnee I*; near English Cay, Bahamas, 190 fathoms; notes).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 647 (Snapper Bank; notes).—Gislén, Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11 1934, p. 25.—H. L. Clark, Mem. Soc. Cubana Hist. Nat., vol. 15, No. 1, May 1941, p. 8 (*Atlantis* stas. 3303, 3465, 3466, 3482; notes).

Stylometra (undescribed form) A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14.

Alecto serrata Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 358, footnote 1 (of Oersted MS=*spinifera*, according to A. H. Clark).

Antedon spinifera var. *brevispina* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, April 1912, p. 362, second line (characters; Montserrat, 88 fathoms [*Blake* station 155], and St. Lucia, 278 fathoms [*Investigator*]), pl. 2, fig. 7 (St. Lucia, 278 fathoms).

Description.—The centrodorsal is very small, hemispherical or low-conical, the bare apical area convex and spinous. The cirrus sockets are arranged in 10 crowded columns, one or two in each column.

The cirri are XI–XX, 40–80, from 35 to 50 mm. long, or from one-third to half the arm length. The longest cirrus segments, the sixth or seventh, are usually between two and three times as long as broad and are centrally constricted; the distal cirrus segments are very short. The segments beyond the basal third of the cirri are provided with long, slender, and sharp dorsal spines.

The radials are over twice as broad as long with a prominent median spine. The IBr_1 are short, between two and three times as broad as long. The IBr_2 (axillaries) are almost triangular. The IIBr, IIIBr, and IVBr series are 2, similar to the IBr series but with the component ossicles progressively longer. Slight synarthrial tubercles are present. The elements of the division series are bordered with stout spines, with occasionally other spines scattered over the dorsal surface.

The 25–30 or more arms are from 65 to 140 mm. long. The lower brachials are about as long as broad with parallel sides and very prominent articulations. After about the eighth the brachials become wedge-shaped with concave anterior and posterior borders, gradually becoming more elongate distally. The first eight or nine brachials, like the elements of the division series, are bordered with stout spines, sometimes with other spines scattered over the dorsal surface. Beyond the eighth or ninth brachial these spinous edgings become obsolete and strong, elongate, curved, and overlapping processes develop on alternating sides of the median line. These processes gradually approach the median line, at the same time becoming somewhat smaller, until in the outer part of the arm they are relatively small, median in position, and finally disappear altogether. This feature is subject to great variation; in some specimens it is extraordinarily developed, in others almost entirely lacking.

Syzygies occur between brachials 3+4, again from between brachials 26+27 to between brachials 32+33, and distally at intervals of 4–9 musuclar articulations, the lesser number being found in the more distal portion of the arms.

In an average large specimen P_1 is 7 mm. long with 15 segments of which the first two are about as long as broad and the remainder become progressively elongated. P_2 is 11 mm. long; the first segment is about as long as broad, the others elongated. P_3 resembles P_1. P_4 is similar, but shorter. These pinnules are all slender and stiff. From P_5 to about P_{14} the pinnules are slightly shorter than P_4 but stouter and strongly carinate dorsally; the first segment is somewhat trapezoidal, the second is enlarged and about as long as broad, and those following are smaller and somewhat longer than broad. The distal pinnules are slightly longer and more slender with the enlargement of the second segment not quite so strongly marked.

The color "varies from almost white through pale straw color to a light yellowish brown." Small specimens are the lightest and large specimens the darkest.

Notes.—The specimens from *Albatross* station 2354 are of average size.

One of the specimens from *Albatross* station 2165 is medium sized with 30 arms and very spiny. Another is similar but has about 20 arms, IIIBr series being present on one ray.

The specimen from *Albatross* station 2169 is similar to that from station 2354.

The specimen from *Albatross* station 2337 is medium sized or rather small with the arms 75 mm. long and the cirri X, 40 mm. long. The dorsal spines on the brachials are remarkably developed.

Two specimens from *Albatross* station 2342 are of medium size; one has 25 arms and cirri with 45–50 segments, the other has 30 arms and cirri with 35–40 segments.

Three small specimens from *Albatross* station 2346 are probably immature; the arms are 55 mm. long with well developed brachial spines and the cirri are 26 mm. long with 40–45 segments.

A specimen from *Albatross* station 2345 is of average development; the arms are 90 mm. long with strongly developed brachial spines and the cirri are XIV, 40.

The specimens from *Albatross* station 2349 are rather small.

From *Albatross* station 2336 comes a very large specimen with 30 arms 140 mm. long; the long dorsal spines are rather poorly developed and die away before the middle of the arms is reached. The cirri are 50 mm. long with 65–80 segments, none of which are longer than broad; the longer proximal segments, which are almost as long as broad, are characteristically constricted centrally. The color is rather dark brown.

Dr. Clemens Hartlaub gave a general account of 21 specimens from Blake stations 155, 220, 231, 232, 249, 259, 269, 290, 292, 297, 298, and 299. The largest number of specimens came from the stations off St. Vincent. He called attention to the uniformity of the bottom conditions on which this species occurs—rocks, coarse sand, coarse sand and rocks, coarse coral sand and broken shells, calcareous stones, broken shells and coral, and coral and coralline. He gave the following summary of the characters of the species: The centrodorsal is thick, short-columnar, dorsally sometimes rounded, sometimes more flattened, with a large bare dorsal pole which has a rough surface showing small sharp spines and traces of five interradial ridges, which become stronger on the sides of the centrodorsal, where they separate the five radial pairs of cirrus sockets from each other. The cirrus sockets are arranged in 10 columns of 3 or 4 each, though the cirri present in each column are never more than 2.

The cirri are about XV, with up to 70 segments, and reach 40 mm. in length. They are long with the segments in the proximal half, except for the basal, elongated, and those in the distal half short. The very uniform short segments in the distal half of the cirri bear the usual spines, their dorsal profile being prominently crenulate.

The radials are visible. The IBr_1 are about as long as the IBr_2 and are not incised. The IBr_2 (axillaries) are approximately rhombic and rather short. The IIBr and IIIBr series are 2. As a rule IIIBr series are developed on the inner branch from each IIBr series so that each postradial series bears 6 arms arranged in 1, 2, 2, 1 order. Occasionally IVBr 2 series are developed.

The ossicles from the IBr_1 onward are laterally free. There is an exception to this, however, in a specimen from *Blake* station 249 (Grenada) in which the IBr_1 are in lateral contact by their lateral edges which, however, are not flattened laterally. Slight synarthrial tubercles are present. The elements of the division series have the outer surface concave. There is never any trace of lateral flattening. On all the ossicles of the division series there are relatively long, straight, pointed, and scattered spines which are especially numerous along the edges. Occasionally (as in two specimens from Montserrat) these are entirely confined to the ambulacral margins of the ossicles.

There are 30 arms about 100 mm. long which even at the base, and especially farther out, are strongly compressed laterally. The first brachials are somewhat broader than long and are not entirely in contact interiorly. The second brachials are squarish. The first and most of the second brachials bear spines resembling those of the elements of the division series on their proximal and distal edges. The first syzygial pair (composed of brachials 3+4) is as long as the first and second brachials together. The epizygal (fourth brachial) has several stronger spines on its distal border of which one is especially strong. The five following brachials are approximately as long as broad, and those succeeding are trapezoidal, gradually passing to approximately triangular. The brachials remain triangular until about the middle of the arm when they again become trapezoidal. The brachials in the proximal third of the arm are rather strongly saddle-shaped. The five or six brachials following the first syzygial pair have on each side of the distal edge a small group of minute spines, and a single spine on the dorsal surface that also stands near the distal edge. These sharp dorsal spines, which are directed obliquely distally and outwardly, have at first a more central position, but they soon move to the longer side of the brachials so that they come to alternate in position on succeeding brachials. The stoutness of the dorsal spines is already considerable on the seventh brachial, and increases rapidly and markedly; at the same time the form becomes like that of a curved pick, strongly compressed laterally. The base of the spines becomes constantly longer and finally extends for the entire length of the dorsal surface of the brachials. In the outer half of the arms the stoutness of the spines decreases again, corresponding to the decrease in size of the brachials

The first syzygy is between brachials 3+4 and the second from between brachials 34+35 to between brachials 39+40, or even farther out—between brachials 45+46 in a specimen from Montserrat. Then there is usually an interval of 7 muscular articulations, and the distal intersyzygial interval is 4–6 muscular articulations A specimen from *Blake* station 298 (Barbados) has the second syzygy frequently between brachials 21+22, and in one arm it is between brachials 15+16.

P_1 on an outer arm from a IIBr axillary is weak and slender, and of very variable length, sometimes about 12 mm. long with about 20 segments. P_2 is 13 mm. long. P_3 is of about the same length as P_2, but more slender. P_4 is scarcely half as long, with 9–10 segments. The segments of all these pinnules are rounded and greatly elongated with the exception of the outermost and the basal which, however, are somewhat longer than broad; they bear small spines on their distal ends. The pinnules remain of the same length up to about P_7 or P_8, the length of the pinnules following increasing. The segments of the pinnules meanwhile become thicker and relatively shorter and are no longer angular. Already on P_4 the second segment shows a slight broadening and elongation on the side toward the centrodorsal. Both these features increase markedly on the pinnules following and persist far out along the arm. On the later pinnules the first segment is also broadened, and toward the end of the arms only the first is broadened. The pinnules of the middle arm region are commonly 6 mm. long with about 13 segments of which the lowest are much broadened while those following are somewhat elongated and taper rapidly. The greatest length of the distal pinnules is 8 mm.

Toward the ends of the arms they become shorter. The segments of the lowest pinnules have small spines on their distal edges. The relative length of the proximal pinnules is very variable. On the same specimen P_2 is sometimes longer than P_1, and sometimes it is shorter, occasionally very small, and this is true of wholly comparable arms, as for instance of arms from a IIBr axillary. This inconstancy holds for the outer as well as for the inner arms. On many arms from a IIBr axillary Hartlaub found all three of the lowest pinnules of the inner side (P_a, P_b, and P_c) very small, though sometimes they are of about the same length as the pinnules of the outer side (P_1, P_2, and P_3).

The pinnules have prominent side and covering plates. When viewed from the ventral side of the pinnule the side plates appear to alternate with each other and to form a continuous zigzag wall.

The disk is strongly incised and is beset with irregularly distributed spines. Sacculi are numerous on the pinnules and very thick and crowded on the arms. The size of the sacculi is proportionate to that of the underlying ossicles.

The color in alcohol is brownish white, the arm bases sometimes somewhat darker. The disk is bright brown with a reddish tinge.

Hartlaub wrote that the two specimens from Montserrat in 88 fathoms (*Blake* station 155) and two from St. Lucia in 278 fathoms (*Investigator*) differ so markedly from the others that they may be regarded as representing a special variety for which he proposed the name *brevispina*. According to him the special characters of var. *brevispina* are: (1) Almost complete absence of the small sharp spines on the ossicles of the division series; (2) markedly weak development of the pick-shaped spines on the brachials; (3) much stronger development of the spines on the segments of the lower pinnules; (4) more deeply saddle-shaped ossicles of the division series; (5) deeper yellow-brown color, with a darker shading of the division series; and (6) more pentagonal and longer IBr axillaries.

Regarding a very young specimen of which a figure had been prepared by Carpenter, Hartlaub said he believed he had found it in the material sent him, although it bore no label in Carpenter's hand and was much more fragmentary than the figure showed. The specimen measures 6 mm. from the centrodorsal to the tip of the longest arm stump. The cirri are broken off.

Carpenter's figure, according to Hartlaub, is not correct in certain details. It shows in the middle of the radial a strong longitudinal ridge which is not present; instead, there are two small spines, one more proximal, the other more distal. A fairly deep cleft between the centrodorsal and the radials is not once indicated although in young, as in older, individuals such a cleft is commonly present and is fairly characteristic of the species.

In a very young specimen from Barbados there is a subradial cleft, and the radial has a swelling on either side. The lateral swellings of two adjacent radials form a sort of base against which the proximal end of the interradial ridge of the centrodorsal rests. A similar interradial structure is found also in fully grown individuals.

Carpenter's figure is further inexact in that the brachials are shown as smooth whereas in the specimen spines are developed in many places. The spinosity in this species appears very early, as is shown by other small specimens. On the side opposite that shown in the figure a IIBr 2 series is developed, so that there are at least 11 arms.

Hartlaub said that after the removal of the cirri the centrodorsal shows five strong interradial ridges and five weaker midradial ridges. As a result of the presence of these ten ridges the ventral surface of the centrodorsal is rather decagonal than pentagonal. The radial grooves are approximately triangular, the basal grooves moderately deep and broadened in the middle. The opening of the central cavity shows ten convex projections.

The dorsal surface of the radial pentagon is approximately pentagonal, with a well-developed basal star. The rosette and basal bridge are well developed. The basals almost always show in the middle of the ventral surface a sharp carination. The dorsal surface of the basal rays shows irregular unevennesses. The peripheral ends are sometimes reduced, sometimes broad, in basal rays from the same specimen, these structures appearing to be rather variable even in a single example. Centrally the basal rays are set off from the rosette part by a weak, necklike connection. The rosette part shows on the ventral surface two small openings, on the dorsal surface a single large opening.

The sculpture of the articular faces of the radials, according to Hartlaub, is well marked and, though minor variations occur, the main features are constant in different individuals (see Part 2, p. 46, figs. 72, 73, p. 43). A median vertical ridge is present, through this is short since the distal border has a broad and deep median incision. It is only slightly raised, very broad, and very deep since the excavations of the joint surface abut against it in the form of niches. The muscular fossae are in general rather flat and are separated from the somewhat more deeply excavated interarticular ligament fossae by prominent diagonal ridges. The relatively strong development of the dorsal ligament fossa is striking. The central canal is situated approximately in the center of the articular face. At the base of the radials are two lateral knobs directed dorsally, forming with the corresponding structures of the neighboring radials bases against which the interradial ridges of the centrodorsal rest. The central cavity, as viewed ventrally, is bordered by five vertical pairs of laminae, the floors of the muscular fossae, the five pairs being separated by five radial notches. The components of these pairs are separated by deep interradial clefts. Since the upper ends of the laminae are curved the circumference of the central cavity has a scalloped appearance.

Carpenter's original description, based upon the specimen in the Paris Museum collected by Duchaissaing in 1870, was as follows:

> Cirri 12–20; long and slender, composed of 40–60 joints, the later ones of which bear dorsal spines. The rays may fork four times, each subdivision consisting of 2 joints not united by a syzygy. Usually, however, there are not more than 2 axillaries, the distichal [IIBr] and the palmar [IIIBr], above the radials [radials and IBr series]; and palmars are frequently only developed upon the inner pair of the 4 secondary arms; so that there are 30 arms in all (as in the Paris specimen), viz., 6 on each ray, in the following order: 1, 2, 2, 1. Tolerably large, sharp spines are scattered irregularly over the calyx and arm bases. The arm-joints are triangular in outline, alternating with one another from side to side; and from near the base of each triangular surface there rises a strong curved spine, which projects forwards and slightly outwards. On the lower parts of the arms, therefore, there is a double row of these spines alternating right and left of the median dorsal line; but farther out, as the joints become more and more compressed laterally, the two rows gradually coalesce into a single median one, the spines at the same time becoming less and less prominent. The disk bears a fairly complete anambulacral plating, and there is a double row of plates along each edge of the pinnule ambulacra, viz., side plates resting on the pinnule joints and supporting the covering plates which overlap one another alternately from opposite sides. The color varies from almost white through pale straw color to a

light yellowish brown. The diameter of the disk is 6 or 7 millimeters, and the spread of the arms about 20 centimeters.

I examined the specimen from Guadeloupe at the Paris Museum in 1910. It is a rather slender example, of medium size.

Hartlaub pointed out that it is difficult to see why Carpenter made this species, which has the division series laterally free, the type of his *Spinifera* group which is characterized by laterally sharply flattened ("wall-sided") division series. He also noted that Carpenter did not mention the characteristic remoteness of the second syzygy, and that he said nothing about the proximal pinnules.

According to Miss Boone the larger specimen from off English Cay, Bahamas, has an arm length of 74 mm. and cirri 28 mm. long, and the smaller has the arms 72 mm. and the cirri 28 mm. long.

The specimen from the Snapper Bank has 27 arms which are about 120 mm. long.

The two specimens from *Blake* station 155 in the Museum of Comparative Zoology are rather small.

A specimen from *Blake* station 269 in the Museum of Comparative Zoology has 30 arms.

Dr. H. L. Clark wrote that the *Atlantis* dredged two small specimens and one large one with 29 arms nearly 100 mm. long off Matanzas, Cuba, in 190–200 fathoms.

From the specimens that I have been able to examine it would appear that this species is most abundant and reaches the largest size off the northern coast of Cuba in the vicinity of Habana. Farther west, toward Yucatán, the size decreases, and eastward and southward along the Lesser Antilles the average size is also distinctly less, specimens from Barbados, St. Vincent, and Grenada all being quite small.

Commensals.—Hartlaub noted that on the specimens from St. Lucia (*Blake* station 220 and *Investigator*) there were small barnacles. Barnacles of the genus *Scalpellum* are common on the cirri of this species throughout its range (see Part 2, p. 639, and pl. 53, fig. 1345). A specimen in the Museum of Comparative Zoology from *Blake* station 269 carries six of these on its cirri.

Localities.—Bahamas; near English Cay; yacht *Pawnee I*, April 1925 [Boone, 1928] (1).

Albatross station 2354; northeast of Cozumel Island, off the coast of Yucatán (lat. 20°59′30″ N., long. 86°23′45″ W.); 238 meters; coral bottom; January 22, 1885 (1+. U.S.N.M., 34567, 34603).

Albatross station 2165; off Habana, Cuba (lat. 23°10′39″ N., long. 82°20′28″ W.); 366 meters; coral bottom; May 1, 1884 (2, U.S.N.M. 16901, 16902).

Albatross station 2169; off Habana, Cuba (lat. 23°10′28″ N., long. 82°20′27″ W.); 143 meters; coral bottom; May 1, 1884 (1, U.S.N.M. 34649).

Albatross station 2337; in the vicinity of Habana, Cuba (lat. 23°10′39″ N., long. 82°20′21″ W.); 364 meters; coral bottom; January 19, 1885 (1, U.S.N.M., 34568).

Albatross station 2342; in the vicinity of Habana, Cuba (lat. 23°10′39″ N., long. 82°20′21″ W.); 368 meters; coral bottom; January 19, 1885 (2, U.S.N.M., 34565).

Albatross station 2346; in the vicinity of Habana, Cuba (lat. 23°10′39″ N., long. 82°20′21″ W.); 366 meters; coral bottom; January 20, 1885 (3, U.S.N.M., 34566).

Albatross station 2345; in the vicinity of Habana, Cuba (lat. 23°10′40″ N., long.

82°20′15″ W.); 337 meters; fine gray and white coral; January 20, 1885 (1, U.S.N.M., 34563).

Albatross station 2349; in the vicinity of Habana, Cuba (lat. 23°10′40″ N., long. 82°20′15″ W.); 333 meters; coral bottom; January 20, 1885 (4, U.S.N.M., 34564).

Atlantis station 3303; off Playa Baracoa, Habana Province, Cuba (lat. 23°05′ N., long. 82°33′ W.); 475 meters; March 23, 1939 [H. L. Clark, 1941].

Atlantis station 3465; Bahia de Matanzas, Cuba (lat. 23°09′ N., long. 81°27′ W.); 320 meters; May 9, 1939 [H. L. Clark, 1941].

Atlantis station 3466; Bahia de Matanzas, Cuba (lat. 23°09′ N., long. 81°27′30″ W.); 366 meters; May 9, 1939 [H. L. Clark, 1941].

Atlantis station 3482; Bahia de Matanzas, Cuba (lat. 23°09′ N., long. 81°27′30″ W.); 347 meters; May 11, 1939 [H. L. Clark, 1941].

Albatross station 2336; in the vicinity of Habana, Cuba (lat. 23°10′48″ N., long. 82°18′52″ W.); 287 meters; coral bottom; January 19, 1885 (1, U.S.N.M., 34601).

University of Iowa's Bahamas Expedition station 2; about 2.5 miles off Habana, Cuba; 201 meters [H. L. Clark, 1918] (1, U.S.N.M., E. 4500).

Albatross stations 2319–2350; in the vicinity of Habana, Cuba; 60–510 meters; January 17–20, 1885 (5, U.S.N.M., 34561, 34562).

Off Habana, Cuba; *Albatross*, 1885 (1+, U.S.N.M., 35596, 36186).

Cuba; *Albatross* (fragments, U.S.N.M., 36186).

Johnson-Smithsonian Expedition; yacht *Caroline* station 43; southeast of Mona Island, between Haiti and Puerto Rico (lat. 18°03′45″ N., long. 67°48′10″ W.); 439–548 meters; February 11, 1933 (1, U.S.N.M., E. 3910).

Off Puerto Rico; Johnson-Smithsonian Expedition (1, U.S.N.M., E. 5258).

Snapper Bank, off the southeastern corner of Puerto Rico; from a cable; Eastern and Associated Telegraph Company [A. H. Clark, 1929] (1, B. M.).

St. Croix, Virgin Islands [P. H. Carpenter, 1881, as Santa Cruz] (1, C. M.).

Blake station 155; off Montserrat (lat. 16°41′54″ N., long. 62°13′24″ W.); 161 meters; bottom temperature 20.56° C.; January 16, 1879 [von Graff, 1883, 1884; Hartlaub, 1912] (2, M. C. Z., 304).

Blake station 157; off Montserrat; 219 meters; no further data [von Graff, 1884].

Guadeloupe; M. Pierre Duchaissaing de Fonbressin, 1870 [P. H. Carpenter, 1881; A. H. Clark, 1911] (1, P. M.).

Blake station 220; off St. Lucia (lat. 13°50′15″ N., long. 61°03′45″ W.); 212 meters; rock; bottom temperature 14.72° C.; February 16, 1879 [Hartlaub, 1912] (1, M. C. Z., 303).

Off St. Lucia; 508 meters; cable repair ship *Investigator*, Captain Cole [P. H. Carpenter, 1881; Hartlaub, 1912] (fragments of arms, M. C. Z.).

Blake station 290; off Barbados (lat. 13°11′54″ N., long. 59°38′45″ W.); 133 meters; coral, sand, and shells; bottom temperature, 21.53° C.; March 9, 1879 [Hartlaub, 1912].

Blake station 292; off Barbados (lat. 13°13′55″ N., long. 59°38′50″ W.); 102 meters; coral, sand, and broken shells; bottom temperature 23.6° C.; March 9, 1879 [Hartlaub, 1912].

Blake station 297; off Barbados (lat. 13°02′36″ N., long. 59°37′45″ W.); 225 meters; rock; bottom temperature 13.6° C.; March 10, 1879 [Hartlaub, 1912].

Blake station 298; off Barbados (lat. 13°03′28″ N., long. 59°37′40″ W.); 220 meters; rock; bottom temperature 16.11° C.; March 10, 1879 [Hartlaub, 1912] (1, M. C. Z., 65).

Blake station 299; off Barbados (lat. 13°05′00″ N., long. 59°39′40″ W.); 256 meters; coral and broken shells; bottom temperature 13.6° C.; March 10, 1879 [Hartlaub, 1912].

Barbados [A. H. Clark, 1913, 1921] (1, B. M.).

Blake station 231; off St. Vincent (lat. 13°12′10″ N., long. 61°17′18″ W.); 174 meters; sand and broken shells; bottom temperature 16.4° C.; February 20, 1879 [Hartlaub, 1912].

Blake station 232; off St. Vincent (lat. 13°06′45″ N., long. 61°06′55″ W.); 160 meters; coral; bottom temperature 16.67° C.; February 21, 1879 [Hartlaub, 1912] (11, U.S.N.M., 35884; M. C. Z., 116, 302).

Blake station 269; off St. Vincent (lat. 13°07′55″ N., long. 61°05′36″ W.); 227 meters; coral; bottom temperature 14.17° C.; March 3, 1879 [P. H. Carpenter, 1881; von Graff, 1883, 1884; Hartlaub, 1912] (14, U.S.N.M., 22456; M. C. Z., 67, 301).

Blake station 259; off Grenada (lat. 12°03′15″ N., long. 61°46′25″ W.); 291 meters; sand and ooze; bottom temperature 11.9° C.; February 28, 1879 [Hartlaub, 1912].

Blake station 249; off Grenada (lat. 11°48′15″ N., long. 61°48′45″ W.); 479 meters; coarse sand; bottom temperature 8.33° C.; February 27, 1879 [Hartlaub, 1912] (3, M. C. Z., 66).

From Santa Cruz (St. Croix) to Grenada; 147–543 meters [P. H. Carpenter, 1881]. This refers to the specimens collected by the *Blake*.

Caribbean Islands; 146–543 meters [P. H. Carpenter, 1888]. This refers to the specimens collected by the *Blake*.

Geographical range.—Bahamas and Greater and Lesser Antilles westward to Cozumel Island off the coast of Yucatán and southward to Grenada.

Bathymetrical range.—From 102 to 508 (?548) meters; the average of 24 records is 265 meters, but the true average depth is probably considerably less than this.

From the records it would appear that this species occurs in somewhat deeper water in the Bahamas and Greater Antilles (average of 10 records 300 meters) than in the Lesser Antilles (average of 14 records 245 meters) but this probably is due to the fact that most of the specimens from Cuba were collected during intensive work on and about the so-called "*Pentacrinus* grounds" off Habana.

This species occurs in water of less depth than would appear from the records, for the type specimen from Guadeloupe and the specimen in the British Museum from Barbados were brought up on fishermen's lines.

Thermal range.—From 8.33° to 23.6° C.; the average of 12 records is 15.93° C.

Bottom.—This species inhabits hard bottom, 70 percent of the bottom records being coral, alone, or in a few cases with broken shells, or broken shells and coarse sand. Three records show rocky bottom. A single bottom sample showed sand and ooze.

History.—The first known specimen of this species was brought from the Danish West Indies (now the Virgin Islands) to the Copenhagen Museum where it received from Prof. Andreas S. Oersted the manuscript name of *Alecto serrata*, though he never described it.

In his preliminary report upon the comatulids collected by the United States Coast urvey steamer *Blake* in 1878 and 1879, which was published in 1881, Dr. Philip Herbert Carpenter wrote that the two species which from their abundance appear to be especially characteristic of the Caribbean Islands, ranging from Santa Cruz (St. Croix) to Grenada, are an *Antedon* and an *Actinometra*, both of which had been obtained prior to the *Blake* expedition. He said that in 1870 M. Duchaissaing had brought from Guadeloupe to the Paris Museum a fine specimen of *Antedon* with 30 very spiny arms. Professor Perrier having kindly permitted him to examine it and to make a note of its characters, he readily recognized the species in the *Blake* collection, and proposed to call it *Antedon spinifera*. Carpenter noted that it had been obtained by the *Blake* at 10 stations in depths of from 80½ to 297 fathoms. It was most abundant at station 269 in 124 fathoms off St. Vincent, and he said that it was also dredged in 278 fathoms off St. Lucia by the *Investigator*. He then described *Antedon spinifera* in considerable detail. The *Actinometra* to which he referred was *Neocomatella pulchella* (see Part 3, p. 124). Carpenter's mention of Santa Cruz was based upon Professor Oersted's specimen at Copenhagen which he had examined, although he nowhere referred to it.

In 1882 Prof. Francis Jeffrey Bell proposed a specific formula for this species, which was criticized and emended by Carpenter early in 1883.

Prof. Ludwig von Graff in 1883 described *Myzostoma agassizii* (see Part 2, p. 664) including among the localities *Blake* stations 155 and 269 where he said the host was apparently *Antedon spinifera*.

In his report upon the stalked crinoids of the *Challenger* expedition published in 1884 Carpenter called attention to the fact that in certain recent pentacrinites, as *Endoxocrinus parrae* ("*mülleri*"), *Diplocrinus maclearanus*, *D. alternicirrus*, and *Annacrinus wyvillethomsoni* secondary and tertiary axillaries are limited to the outer arms of each successive pair whereas *Stylometra spinifera* often shows exactly the reverse condition to this, the IIIBr axillaries being frequently developed only on the inner pair of the four secondary arms.

In 1884 Professor von Graff described *Myzostomum pictum* from *Blake* station 157, the host being probable *Stylometra spinifera* (see Part 2, p. 663), and gave this species as the probable host of *Mzyostomum agassizii* from *Blake* stations 155 and 269.

In 1884 William Neale Lockington gave an account of the occurrence of this species and *Actinometra* (*Neocomatella*) *pulchella* in the Caribbean region taken from the notes published by Carpenter in 1881.

In the *Challenger* report on the comatulids published in 1888 this species was not treated in detail as it was not secured by the *Challenger*, but various notes on it were given. Carpenter pointed out that it not infrequently has exactly 30 arms owing to the presence of IIIBr axillaries on the inner pair of every four secondary arms, and that occasionally IVBr series are present. He made it the type of the *Spinifera* group the members of which he characterized as "Bidistichate species with the radial axillaries [IBr_2] and some of the following joints more or less wall-sided, and a well-marked ambulacral skeleton on the pinnules." He compared *Antedon spinifera* in detail with his new species *Antedon* (*Stenometra*) *quinquecostata*, and in much less detail with *A.* (*Stiremetra*) *lusitanica*. The range of *Antedon spinifera* was given as the Caribbean Islands in 80–297 fathoms.

Alexander Agassiz in 1888 published a résumé of Carpenter's original account of this species, accompanied by a very characteristic figure.

In 1889 Carpenter compared the arm division of *Antedon elegans* (= *Zygometra comata*), in which IIIBr series frequently occur on the inner branches from the IIBr axillaries, to that of this species.

Wilhelm Minckert in 1905 noted that in this species single hypozygals or epizygals in the proximal portion of the arms are not smaller than the other brachials. His notes were based upon specimens from the *Blake* collection.

In 1907 I referred this species to my new genus *Thalassometra*, and later in the same year I compared the brachial spines of *Thalassometra spinifera* with those of a new species, *Thalassometra hawaiiensis*. In 1909 I established the new genus *Stylometra* for this species and "an undescribed form from the Caribbean Sea." The latter was described by Hartlaub in 1912 as *Antedon spinifera* var. *brevispina*. During a visit to Paris in 1910 I examined the specimen brought back by M. Duchassaing from Guadeloupe which in 1911 I said was "Une exemplaire de moyenne grandeur, un peu mince."

In his report published in 1912 on the comatulids collected by the United States Coast Survey Steamer *Blake* in 1878 and 1879 Dr. Clemens Hartlaub recorded *Antedon spinifera* from 12 *Blake* stations and also recorded specimens that had been taken from a cable raised from 278 fathoms off St. Lucia by the cable repair ship *Investigator*, Capt. H. Cole. Dr. Hartlaub gave a very detailed and most excellent account of this species, with many excellent figures. He described a new form, *Antedon spinifera* var. *brevispina*, which was the same as my "undescribed form" mentioned in 1909. The *Blake* collection had originally been sent to Dr. P. H. Carpenter for report, and was turned over to Hartlaub after Carpenter's death. Together with the specimens there were numerous drawings that had been prepared under Carpenter's direction. These were largely unidentified. Such as could be identified from specimens in the *Blake* collection or from *Albatross* specimens in the National Museum were retained and the others discarded and original drawings prepared under Hartlaub's direction substituted.

In 1913 I recorded a specimen from Barbados that I had examined in the British Museum in 1910. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *Stylometra spinifera* was included and its synonymy was given.

In his report on the Crinoidea and Echinoidea collected by the Bahama Expedition of the University of Iowa in 1893 which was published in 1918 Dr. Hubert Lyman Clark recorded a single specimen of *Stylometra spinifera* from station 2. He said "A single fine specimen of this beautiful species is all that the present collection contains. Unfortunately the cirri are all broken, but enough is left of one to reveal the characteristic features."

In my memoir on the unstalked crinoids collected by the *Siboga* Expedition published in 1918 I inserted the genus *Stylometra* in a key to the genera of the Thalassometrinae, giving the range as from Yucatán to Grenada, and gave the synonymy of *S. spinifera*. In a paper on the crinoids and brittle-stars of the Barbados-Antigua Expedition of the University of Iowa in 1918 which was published on March 15, 1921, I summarized all the records for this species in the vicinity of Barbados. In the same year in another paper I republished the figure given in Part 1 as figure 35 on page 73 showing the progressive individualization of the hypozygals of the syzygies distally along the arms. In my memoir on the crinoids of the Danish *Ingolf* Expedition published in 1923 I gave the range of *Stylometra spinifera* as "From Yucatan to northern Cuba and southward to Barbados and Grenada; definitely known from 102–508 meters: but it occurs in lesser depths."

In 1924 Prof. Torsten Gislén described the syzygies in a specimen with the arms about 90 mm. long. He did not give the locality of the specimen; it was one of those dredged by the *Albatross* in the vicinity of Habana, Cuba (stations 2319–2350).

In 1928 Miss Pearl Lee Boone recorded "two fine specimens" of *Stylometra spinifera* from off English Cay, Bahamas, in 190 fathoms, where they had been dredged by Harry Payne Bingham on his yacht *Pawnee I.* In the introduction to the paper she said that the crinoids secured by the expedition are "represented by several specimens of one species, *Stylometra spinifera*," and gave notes on the commensalism of the species. She said "Interesting notes were obtained of commensalism between this crinoid and three species of Crustacea, an anomuran, *Uroptychus rugosus* Milne Edwards, an isopod, *Arcturus pawneeanus* Boone, and a pedunculate barnacle, *Scalpellum rodstomi* Boone. A species of ophiuran, *Ophiothrix angulata* Say, was also found entwined in the arms of one of these specimens." Barnacles of the genus *Scalpellum* are commonly found attached to the cirri of this species throughout its range (see Part 2, p. 639, pl. 53, fig. 1345). The two other crustaceans and the ophiuran mentioned are not commensal with crinoids, though they occur in the same areas; they were simply crushed in among the arms of the crinoids during capture.

In 1929 I recorded a specimen in the British Museum that was taken from a cable crossing the Snapper Bank off the southeast corner of Puerto Rico by a cable repair ship of the Eastern and Associated Telegraph Co.

In 1943 Prof. Torsten Gislén gave further notes on this species.

In 1941 Dr. Hubert Lyman Clark recorded 10 specimens from *Atlantis* station 3303, off Playa Baracoa, Cuba, in 260 fathoms, and three from stations 3465, 3466, and 3482, off Bahia de Matanzas in 190–200 fathoms, giving notes on the latter.

Genus COSMIOMETRA A. H. Clark

Antedon (part) Hartlaub, Nachr. Ges. Göttingen, May 1890, pp. 169, 173, and following authors

Thalassometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360.

Stenometra (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 15.

Cosmiometra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 16 (diagnosis; genotype *Thalassometra komachi* A. H. Clark, 1908); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 10 (represented in the West Indies by *Stylometra*), p. 13 (common to southeastern Africa and the Bay of Bengal, but not occurring in the Arabian Sea); Crinoids of the Indian Ocean, 1912, p. 10 (2 species in the Hawaiian Islands), p. 12 (represented in the southeast African region), p. 13 (corresponds to the West Indian *Stylometra*), p. 24 (next to *Thalassometra* the most widely spread genus of the family; range), p. 59 (in key), p. 214 (original reference; genotype); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1914, pp. 4 and following (represents *Stylometra* in the Indo-Pacific; range); Die Crinoïden der Antarktis, 1915, p. 125 (certain species of this genus show the characteristic features of *Anthometra adriani*), p. 181 (range; represented in the Atlantic by *Stylometra*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 148 (in key; range), p. 153 (key to the included species).—Gislén, Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Diagnosis.—A genus of Thalassometridae in which the brachials beyond the basal are laterally compressed and carinate; the divisions series, which are all 2, vary from strongly rounded to more or less flattened dorsally with the dorsal surface of the component ossicles plain and unmodified, or with the edges everted or bordered with fine spines or bands of fine spines; and the brachial carination is not produced into long overlapping spines. The 20–30 arms are 70–130 mm. long, and the slender cirri are 25–50 mm. long with 29–74 segments.

Geographical range.—From southern Japan and the Hawaiian Islands to southeastern Australia (Bass Strait) and westward to Ceylon, the Maldive Islands, and Saya de Malha.

Bathymetrical range.—From 183 (?128) to 730 (?740) meters.

Thermal range.—From 5.44° to 23.2° C.

Remarks.—The genus *Cosmiometra*, of which *Stylometra* is the Atlantic representative, is related to *Parametra* and *Lissometra*, from which, however, it appears to be quite distinct. When fully developed the species are easily recognized by their long and slender cirri with numerous segments, combined with the 20 or more arms, all the division series being 2, and the arms being laterally compressed and carinate in their middle and outer portions.

The 10 species of *Cosmiometra* fall into two groups. In one of these groups the arms are probably 30 in number in fully developed individuals, one IIBr 2 series being present on each of the two outer sides of each postradial series. This group is known only from the Hawaiian Islands (*delicata*) and from Ceylon and the Maldive Islands (*leilae*). The two species of this group are probably not closely related to each other, but instead are of independent origin from the stem type of the other group. In the other group there are normally 20 arms, all the IIBr series being present. In spite of considerable variation in detail from one species to another, the species of this group appear to be quite homogeneous, and, except in the number of arms, they do not differ from the species of the first group. In the Atlantic genus *Stylometra* the single species, *S. spinifera*, may have either 20 or 30 arms, but this does not appear to be the case in any species of *Cosmiometra*.

History.—The first known species of this genus (*conifera*) was described as an *Antedon* by Dr. Clemens Hartlaub in 1890, and the second (*woodmasoni*) was also referred to *Antedon* by Prof. F. Jeffrey Bell in 1893. To these I added *Antedon aster* in 1907, later in the same year transferring them all to my new genus *Thalassometra*. In 1908 I added *Thalassometra delicata*, *Th. crassicirra*, and *Th. komachi*.

On the establishment of the genus *Cosmiometra*, with the genotype *Thalassometra komachi* A. H. Clark, 1908 (=*Antedon aster* A. H. Clark, 1907), I included in it *crassicirra*, *delicata*, *komachi*, and *woodmasoni*. Later in 1909 *conifera* was recognized as a member of this genus. In 1915 *aster* was redetermined as the young of *komachi*, the latter name therefore falling into the synonymy of the former. Since 1915 the status of the genus *Cosmiometra* has remained unchanged.

In the key to the species of the genus *Cosmiometra* published in 1918 in my memoir on the unstalked crinoids of the *Siboga* expedition there appears the specific name *koehleri*, with the locality "St. Vincent, West Indies, 158 meters." This supposed new species, which was never formally described, proved to be based upon a specimen of *Horaeometra duplex*.

KEY TO THE SPECIES IN THE GENUS COSMIOMETRA

a^1. Arms 23–28 in number, the IIIBr series always on the outer side of the IIBr series; cirri with 31–40 segments, 30–35 mm. long; arms 90–110 mm. long.

  b^1. Cirri in 15 columns on the centrodorsal; transition segment about the eighth; stout; carination of the brachials high, narrow, and conspicuous (from south of Ceylon to the Maldive Islands; 199–241 meters)--**leilae** (p. 43)

  b^2. Cirri in 10 columns on the centrodorsal; transition segment about the sixteenth; slender; carination of the brachials low and inconspicuous (Hawaiian Islands; 583 meters)---**delicata** (p. 46)

a^2. Arms 20 (or slightly less) in number; no IIIBr series.

  b^1. Longest cirri with more than 50 segments.

    c^1. Elements of the division series and lower brachials with the lateral portions more or less extensively roughened or finely spinous.

      d^1. Cirri with 68–74 segments, half as long as the arms or somewhat longer; cirri 45–50 mm. long, arms about 90 mm. long (Bass Strait. between Australia and Tasmania; 128–183 meters)--**dasybrachia** (p. 47)

      d^2. Cirri with less than 65 (usually 40–55) segments, less than half as long as the arms; arms 100–130 mm. in length.

        e^1. Edges of the elements of the division series and first two brachials everted and roughened; cirri arranged in 15 closely crowded columns on the centrodorsal (Sagami Bay, Japan; 183–730 [?740] meters)--**aster** (p. 49)

        e^2. All but the median third of the dorsal surface of the elements of the division series and first two brachials finely spinous or tubercular; cirri arranged in 10 definite columns 2 in each radial area, on a conical centrodorsal (Philippines to Celebes and the Kei Islands; 245–621 meters)----------------------------------**philippinensis** (p. 52)

    c^2. Elements of the division series and lower brachials with the lateral borders and the proximal and distal edges smooth, without spines.

      d^1. Cirri with about 70 segments, slightly over half as long as the arms, arranged in 10 columns on the centrodorsal; cirri 45 mm. long, arms about 70 mm. long (southern Japan)--**conifera** (p. 56)

      d^2. Cirri with 50–54 segments, about one-third of the arm length, irregularly arranged in from one to three columns in each radial area of the centrodorsal; cirri 45 mm. long, arms 130 mm. long (Hawaiian Islands; 249 meters)---------------**crassicirra** (p. 58)

  b^2. Cirri with not more than 41 segments.

    c^1. Carination of the division series and first two brachials broad and low; outer brachials very strongly overlapping and broadly carinate; cirri slender (Saya de Malha; 247 meters)--**gardineri** (p. 63)

    c^2. Carination of the division series and first two brachials narrow and higher; outer brachials moderately overlapping and narrowly carinate; cirri stouter.

      d^1. Division series and first two brachials with the lateral edges not produced (Sahul Bank)--**woodmasoni** (p. 60)

      d^2. Division series and first two brachials with the lateral edges produced and slightly everted, broadly scalloped or bearing two or three blunt tubercles (off southwestern Mindanao; 292–365 meters)--**iole** (p. 61)

COSMIOMETRA LEILAE A. H. Clark

PLATE 5, FIGURE 17; PLATE 6, FIGURE 23

Cosmiometra leilae A. H. CLARK, Rec. Indian Mus., vol. 34, pt. 4, 1932, p. 551 (listed), p. 565 (*Investigator* station 465; description; comparisons), pl. 20, figs. 18–19; John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936 (Jan. 1937), p. 87 (listed), p. 92 (*Mabahiss* station 157; notes; range), pp. 101, 103.

Diagnostic features.—This is a stout and robust species with 23–28 arms; and the cirri, which are relatively stout and rather short and have the transition segment at about the eighth, are arranged in 15 columns on the large centrodorsal. The arms are 90–100+ mm. long, and the cirri are 30–35 mm. long with 31–40 segments.

Description.—The centrodorsal is thick discoidal, about 4 mm. in diameter at the base and 1.5 mm. high, with the broad rugose dorsal pole about 3 mm. in diameter. The cirrus sockets are arranged in 15 crowded columns of one or two each, there being three columns in each radial area; but rarely the median column is absent, leaving two lateral columns separated by a bare slightly depressed space as broad as a column, or the central column may consist of a single more or less undeveloped cirrus. The radial areas on the centrodorsal are not usually differentiated, but in rare cases there is a narrow sharp ridge that runs down from the ends of the basal rays.

The cirri are XXV, 31–40 (apparently usually about 35), up to 33 mm. in length. The first segment is three or four times as broad as long or even shorter, the second is about twice as broad as the greatest (ventral) length, the third is about half again as broad as long, the fourth varies from slightly broader than long to about one-third again as long as broad, and those following increase in length to the eighth, a transition segment, which is three times as long as the median width. The succeeding segments rapidly decrease in length, the eleventh or twelfth being about as long as broad and the seventeenth and following about half again as broad as long, or sometimes slightly longer. The central portion of the distal dorsal edge of the transition (eighth) segment is slightly produced; on the segments following this is raised into an abrupt high process arising from the end of the second third of the dorsal surface of the segment with, when viewed along the axis of the cirrus, a rounded or more or less lobate distal end. Distally this process gradually narrows and at the same time arises from more and more of the dorsal surface of the segments, becoming on the short outer segments a high and conspicuous dorsal spine with a strongly rounded, but not carinate, dorsal crest, and a roundedly blunted tip. The opposing spine is small, smaller than the dorsal spine on the preceding segment, and blunt; it is terminally situated. The terminal claw is longer than the penultimate segment, rather slender, and moderately and evenly curved.

The ends of the basal rays are prominent in the angles of the calyx as rather small tubercles between the apposed anterolateral angles of the radials and the rim of the centrodorsal.

The radials are short, strongly curved, with the dorsal surface depressed within the rim of the centrodorsal, especially laterally, making the ends of the basal rays conspicuous. The IBr_1 are very short, about six times as broad as the median length, and are in lateral contact. The midradial line bears a rather high median carination. The anterolateral angles may bear single tubercles or short blunt spines. The IBr_2 (axillaries) are very short, about three times as broad as long, and are rhombic with the lateral angles slightly truncated. The entire median line is occupied by a rather high narrow carination, and the edges are slightly everted and produced, most so on the proximal side. Prominent water pores are present beneath the apposed lateral angles of the axillaries. The IIBr series are 2, resembling the IBr series; but the component elements are proportionately longer and the axillaries have much more broadly truncated lateral angles. Rather conspicuous water pores are present on both sides of the IIBr series. The IIIBr series are 2, always externally developed, and resemble the IIBr series. The outer side of the IIIBr axillaries is about three times as long as the inner, the latter being broadly cut away for the formation of the water pore.

The 24–26 arms are probably over 100 mm. long. The first two brachials are prominently carinate, like the elements of the division series. Their borders are practically unmodified, or are very slightly and rather broadly thickened. There is a prominent water pore between the adjacent first two brachials on each arm pair, formed chiefly by the cutting away of the proximal inner angle of the second brachials. A low but prominent median carination, abruptly set off from the dorsal surface of the brachials, runs along the arms to the tip.

P_1 is slender and not greatly stiffened, 10 mm. long with 17 segments. The first segment is about as long as broad, the second is slightly longer than broad, the third is nearly half again as long as broad, and those following slowly and gradually increase in length so that the fourteenth is twice as long as broad and the sixteenth is about three times as long as broad. The distal ends of the segments are very slightly prominent, though not everted or otherwise modified, and the distal angles on the side toward the arm tip are slightly produced, overlapping the base of the segment following.

P_2 is 8 mm. long with 15 segments and resembles P_1. P_3 is 7 mm. long with 12 segments and resembles P_2. P_4 is 5 mm. long with 12 segments.

The lower pinnules are all about equally stout basally, and all taper slowly and evenly to the tip.

Notes.—In one of the specimens dredged by the *Mabahiss* the 23 arms are 95–100 mm. long. The cirri are XVIII, 36–39, 30–35 mm. long; the transition segment is usually the ninth, sometimes the tenth. The division series resemble those of the two original specimens from south of Ceylon, but the elements of the IBr series are often somewhat rugose laterally, with the distal border of the IBr_1, and also of the $IIBr_1$, coarsely scalloped laterally.

Another individual has 28 arms 90 mm. long. The division series have a slightly irregular surface.

In an example with 24 arms the dorsal surface of the division series is scarcely modified.

Other specimens have 25, 24, 23, 23, 20, and 15 arms, the two last being small. There are four additional examples.

Color in life.—A note made at the time of capture of the *Mabahiss* specimens describes the color, on the basis of Ridgway's "Color Standards and Color Nomenclature," as "orange with the aboral surface white."

Remarks.—*Cosmiometra leilae* appears to be most closely related to *C. delicata* from the Hawaiian Islands, but it is a much stouter species with a much broader and lower centrodorsal on which the cirri are arranged in 15 instead of in 10 columns, the transition segment in the cirri is the eighth instead of the sixteenth, and the carination of the brachials is higher, narrower, and more conspicuous.

Localities.—*Investigator* station 465; south of Ceylon (lat. 5°56′ N., long. 81°22′ E.); 199–241 meters; April 22, 1912 [A. H. Clark, 1932] (2, U.S.N.M., E. 3271; I. M.).

Mabahiss station 157; Maldive area (lat. 4°43′48″ N., long. 72°55′24″ E. to lat. 4°44′00″ N., long. 72°54′18″ E.); 229 meters; April 6, 1934 [A. H. Clark, 1937] (13, B. M.; Cairo Mus.).

History.—*Cosmiometra leilae* was described in 1932 from two specimens that had been dredged in 1912 by the Royal Indian Marine Survey steamer *Investigator* at station 465, south of Ceylon. In January 1937, 13 additional specimens were recorded from the John Murray Expedition to the Indian Ocean, 1933–34, that had been secured by His Egyptian Majesty's steamer *Mabahiss* at station 157 in the Maldive region.

COSMIOMETRA DELICATA (A. H. Clark

PLATE 3, FIGURE 9

[See also vol. 1, pt. 1, fig. 367, p. 297; pt. 2, fig. 214, p. 157.]

Thalassometra delicata A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 214 (in key), p. 225 (description; *Albatross* station 3963).

Cosmiometra delicata A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 17 (listed); Crinoids of the Indian Ocean, 1912, p. 215 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 153 (in key; range), p. 154 (references); Rec. Indian Mus., vol. 34, pt. 4, December 1932, p. 566 (compared with *C. leilae*).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 25.—A. H. CLARK, Bernice P. Bishop Mus. Bull. 195, 1949, p. 74 (*Albatross* station 3963), p. 97 (station data).

Diagnostic features.—A slender species with 28 arms; the cirri, which are slender and rather short and have the transition segment at about the sixteenth, are arranged in 10 definite columns on a rather small rounded conical centrodorsal. The arms are 110 mm. in length, and the cirri are 30–35 mm. long with 40 segments.

Description.—The centrodorsal is rounded conical, rather small. The cirrus sockets are arranged in 10 columns, one, more rarely two, to a column.

The cirri are XIII, 40, from 30 mm. to 35 mm. long. The first 2 segments are short, the third is not quite so long as broad, and the fourth is rather longer than broad. The following segments to between the tenth and fifteenth are about half again as long as broad. The transition segment falls between the tenth and fifteenth, but is usually nearer the latter. The first segment after the transition segment is rather longer than broad and those following gradually decrease in length, the terminal being about twice as broad as long. After the transition segment the dorsal distal edge of the segments projects in the form of a sharp transverse ridge which appears as a spine in lateral view. The opposing spine in lateral view is triangular and blunt, and does not reach one quarter the width of the penultimate segment in height. The terminal claw is somewhat longer than the penultimate segment, rather stout, and only moderately curved.

The disk is thickly plated along the ambulacral grooves, and bears scattered calcareous granules in the interambulacral areas. The brachial ambulacra are rather scantily plated, but side and covering plates are well developed on the pinnules. Sacculi are abundant on the pinnules, but small.

The ends of the basal rays are visible as tubercles in the interradial angles of the calyx.

The radials are concealed by the centrodorsal. The IBr_1 are very short, bandlike, with the borders prominent and with a blunt median keel. The IBr_2 (axillaries) are rhombic, about twice as broad as long, with rather prominent borders and a strong rounded median keel. The IIBr and IIIBr series are 2, the latter developed exteriorly in 2, 1, 1, 2 order; both resemble the IBr series. The division series and the first 12 or 15 brachials are sharply flattened laterally.

The 28 arms (in the type) are 110 mm. in length. The first 9 brachials are oblong or slightly wedge-shaped, broader than long, those following becoming triangular or very obliquely wedge-shaped, about as long as broad, and distally wedge-shaped again and elongate. Except for the few more-or-less oblong brachials at the base of the arms all the brachials have strongly produced and finely serrate distal edges which overlap the bases of those succeeding. This overlapping does not involve the entire distal edges of the segments, but only a comparatively small central portion, so that in a lateral view the appearance is given of overlapping spines.

Syzygies occur between brachials 3+4, again about brachials 16+17, and distally at intervals of usually 4 muscular articulations.

P_1 is comparatively slender, though much longer and somewhat stouter than P_2, tapering evenly from the base to the tip, 7 mm. long with 16 segments of which the basal 6 are about as long as broad and those following gradually become elongated. P_2 is 4 mm. long, more slender than P_1, with 11 segments of which the first 2 are about as long as broad and the remainder are longer than broad. The following pinnules decrease in length to the fifth or sixth, which is 3 mm. long, then gradually increase to 9 mm. distally.

The color in alcohol is brownish yellow, with the cirri somewhat lighter.

Locality.—Albatross station 3963; Laysan Island Light, Hawaiian Islands, bearing N. 56°30′ E., 6.6 miles distant; 583 meters; bottom temperature 23.2 C.; white sand and broken shells; May 22, 1902 [A. H. Clark, 1908, 1909, 1912, 1918, 1932, 1949; Gislén, 1934] (2, U.S.N.M., 22690 [type], 35592).

History.—This species was described under the name of *Thalassometra delicata* in 1908 from two specimens from *Albatross* station 3963. It was removed to the new genus *Cosmiometra* in 1909. The two original specimens are still the only ones known.

COSMIOMETRA DASYBRACHIA H. L. Clark

Cosmiometra dasybrachia H. L. Clark, Biol. Res. Fishing Exper. F. I. S. *Endeavour,* 1909–14, vol. 4, part 1, 1916, p. 24 (detailed description; east of Flinders Island, Bass Strait, 70–100 fathoms), pl. 4, fig. 2.—A. H. Clark, Proc. Biol. Soc. Washington, vol. 31, 1918, p. 42 (listed from Tasmania).

Diagnostic features.—A rather slender species with 20 arms; the cirri, which are arranged in 10 definite columns on a moderate sized rounded conical centrodorsal, are slender and very long, somewhat more than half the length of the arms, with 68–74 segments. The arms are about 90 mm. long, and the cirri are 45–50 mm. long.

Description.—The centrodorsal is markedly conical, scarcely 5 mm. in diameter at the base and about 4 mm. high. The cirrus sockets are arranged in 10 columns of 3 or 4 each (about 35 altogether), the columns separated in the midradial line by a rather broad area with a finely roughened surface.

The cirri are about XXXV, 68–74, from 45 to 50 mm. long. The fifth or sixth segment is the longest, much longer than broad, and all the segments but the proximal 15 have the distal dorsal edge produced into what looks like a sharp spine when seen from the side. The distal segments, including this dorsal spine, are twice as broad as long.

The radials are completely concealed except for the small distolateral corner, which is visible in the interradial angles of the calyx. The IBr_1 are crescentic with the proximal margin strongly convex and the distal correspondingly concave; excepting only the distal median portion, the whole surface is rough and spinulose, especially the lateral margins. The IBr_2 (axillaries) are rhomboidal with the anterior margins slightly concave. All the margins are finely serrulate and the lateral surfaces are rough and spinulose. The synarthrial tubercle is smooth and rounded, low but distinct. The IIBr series are 2, very similar to the IBr series; but the lateral spinulose surfaces are much less marked, especially on the axillary, and are nearly wanting on the inner side. The division series and first two brachials have strongly flattened sides. The division series are in closely appressed contact, but the lower brachials are much less so and probably in life hardly touch.

The 20 arms are about 90 mm. long. The first two brachials are similar to the elements of the IIBr series but are relatively much longer and narrower and have no spinulose lateral areas, though the lateral margins are very serrulate and rough. The third-tenth brachials are quadrilateral, the following brachials becoming triangular, the distolateral angle being more and more prominent. Beyond the middle of the arm the brachials become quadrilateral again and nearly as long as broad. Proximally both proximal and distal margins are everted and rough, but beyond the twelfth to fourteenth brachial only the distal margin is conspicuous; even near the tip of the arm, however, the distal margin is not very flaring and it never overlaps the segment following. Beginning at the thirty-fifth brachial, or thereabouts, the distal dorsal surface of each segment is rough with minute spines, and these soon cover the whole median area of the arm; near the arm tip this area is a very narrow band.

The first syzygy is between brachials 3+4. In eleven arms of one specimen, but in only one arm of the holotype, the second syzygy is between brachials 5+6, and the third is somewhere in the region between the eighteenth and twenty-seventh brachials. In the other arms the second syzygy is generally not until after the twentieth brachial. The distal intersyzygial interval is at first 6–8 muscular articulations, but near the tip of the arm it decreases to 4 or 5.

P_1 is about 11 mm. long with 25 smooth segments of which the six basal are much broader than long, somewhat axe-head shaped, and much flattened dorsally, and the remainder are longer than broad, or at least as long as broad, the eighth being the longest. P_2 is similar but only 10 mm. long with only 22 segments. P_3 is similar, but a little shorter. P_4 to P_{10} are more prismatic, only 5–6 mm. long, with 12–14 segments which have the distal margins, and a sharp dorsal keel, finely serrulate. The remaining pinnules are similar but becoming much more slender, longer (8–10 mm.), and with more segments (17–18); the sharp serrate dorsal keel is well marked.

The color in alcohol is yellowish brown; when dry the shade is much lighter.

Notes.—In a cotype which Dr. Clark very kindly permitted me to examine the longest cirrus is 50 mm. long with 74 segments of which the seventh is a transition segment; the longest segments are half again as long as broad. The crest of the dorsal cirrus spines is broad, on the average occupying about the median third of the segments in dorsal view. In lateral view the distal (vertical) edge of the spines is finely serrate, most pronouncedly so in the outer third of the cirri.

The outer (lateral) thirds of the ossicles of the IBr series and IIBr series appear spongy; there are a few small spicules on the adjoining edges of the ossicles of the IIBr series.

The earlier brachials have the borders thickened and rather abruptly everted, though not produced. As the brachials become triangular small spines are developed along the distal border which gradually increase in size, especially those in the middle of the edge from which serrate ridges gradually extend themselves proximally until they completely span the brachial, so that the brachials in the outer half of the arm have a median longitudinal band of fine spines.

Locality.—East of Flinders Island, Bass Strait; 128–183 meters; *Endeavour*, December 4, 1913 [H. L. Clark, 1916; A. H. Clark, 1918 (Tasmania)] (2, M. C. Z., 717; Australian Mus.).

History.—This species was described in 1916 by Dr. Hubert Lyman Clark from two specimens that had been dredged by the Australian Fisheries Investigation ship *Endeavour* east of Flinders Island in 70–100 fathoms on December 4, 1913. Dr. Clark said that while this species resembles both *C. komachi* and *C. helene* in the general character of the arms, the much more numerous cirrus segments, the longer pinnules, and the markedly conical centrodorsal seem to prove that it is quite distinct. He remarked that the genus was not known previously from Australian waters.

In 1918 I listed this species as one of the crinoids known from Tasmanian seas.

COSMIOMETRA ASTER (A. H. Clark)

Plate 6, Figure 21

[See also vol. 1, pt. 2, fig. 215, p. 159.]

Antedon aster A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 145 (description; *Albatross* station 5088).

Thalassometra aster A. H. Clark, Smithsonian Misc. Coll. vol. 50, pt. 3, 1907, p. 360 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 310 (Sagami Bay); Amer. Nat., vol. 42, No. 500, 1908, p. 542 (belongs to a group characteristic of the oceanic area); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (same); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14 (listed); Crinoids of the Indian Ocean, 1912, p. 206 (synonymy; locality).

Thalassometra komachi A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 311 (description; Misaki), p. 540 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 155 (identity with [*Cosmiometra*] *aster*).

Cosmiometra komachi A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 17 (listed); Proc. U. S. Nat. Mus., vol, 39, 1911, p. 549 (compared with *C. philippinensis*); Zool. Anz., vol. 39, No. 11/12, 1912, p. 428 (arms compared with those of *C. helene*); Crinoids of the Indian Ocean, 1912, p. 214 (locality).—H. L. Clark, Biol. Res. Fishing Exper. F. I. S. *Endeavour*, 1909–14, vol. 4, pt. 1, 1916, p. 26 (comparison with *C. dasybrachia*).

Cosmiometra aster A. H. Clark, Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 154 (in key; range), p. 155 (synonymy).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, fig. 176, p. 98 (articulation of a distal pinnule); Vidensk. Medd. Dansk naturh. Foren. København, vol. 83, 1927, p. 3 (stations 15, 25; 180–720 meters), p. 41 (stations 15, 25; notes), pp. 68, 69 (listed), figs. 36, 37, p. 44; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Diagnostic features.—A moderately slender species with 20 arms; the cirri, which are arranged roughly in 15 closely crowded columns on the truncated conical or short columnar centrodorsal, are nearly half as long as the arms; and the elements of the division series and first two brachials have the edges all around everted and roughened, the dorsal surface otherwise smooth. The arms are 125 mm. long and the cirri are 25–40 mm. long with 40–55 segments.

Description.—The centrodorsal is bluntly conical or short columnar with the cirrus sockets arranged roughly in three closely crowded columns in each radial area, or 15 closely crowded columns, with two cirrus sockets to a column. The bare polar area is granulose.

The cirri are XXV, 40–55, from 25 to 40 mm. long. They are basally slender and rounded, becoming much compressed laterally and broad distally. The first four or five segments are about twice as broad as long, the next is about as long as broad, and the following, a transition segment, is about twice as long as its proximal width, decreasing in width distally, with the surface dull and dark like that of the segments preceding in the proximal two-thirds, and light and highly polished in the distal third. The cirri decrease in width at this point. The segments following the transition segment are about as long as broad, the first being usually longer than broad, gradually becoming shorter, and very short distally. At about the fourth segment beyond the transition segment the distal dorsal edge begins to project, soon becoming a deep dorsal spine which arises from the whole of the middorsal line. The dorsal spines on the terminal segments decrease in height. The opposing spine is short and blunt, terminally situated, not reaching half the width of the penultimate segment in height. The terminal claw is stout and moderately curved, rather longer than the penultimate segment.

The ends of the basal rays are visible as prominent, though small, tubercles in the interradial angles of the calyx.

The radials have a strongly curved distal edge, not visible in the median line but extending far up in the interradial angles and surrounding the ends of the basal rays; they reach as far distally as the lateral angles of the IBr axillaries. The IBr_1 are laterally concealed by the interradial anterior extension of the radials and are visible as a triangle with the apex downward in the median line; their edges are everted and roughened. The IBr_2 (axillaries) are over twice as broad as long, rhombic, rising to a low synarthrial tubercle with the IBr_1, the edges all around everted and roughened, the dorsal surface, like that of the IBr_1, perfectly smooth. The IIBr series are 2. The IBr series, IIBr series, and first two brachials are in close apposition and sharply flattened laterally.

The 20 arms are 125 mm. long. The first brachials are wedge-shaped, with the longer side exterior. The second brachials are similar, but nearly twice as large. The brachials following to about the tenth are oblong, about twice as broad as long, those succeeding soon becoming triangular, broader than long, then as long as broad, and distally wedge-shaped again and more or less elongate. The oblong brachials in the proximal portion of the arms have both the anterior and posterior edges everted and roughened. This soon changes to an eversion of the distal ends which are finely spinous, and then to a strong overlapping of the distal ends. The brachials in the proximal third of the arms have the dorsal surface perfectly smooth. In the outer two-thirds the dorsal surface is thickly set with longitudinal lines of fine spines directed forward, giving the outer part of the arms a peculiar velvety appearance. In the proximal third the arms are remarkably deep and compressed; in the outer two-thirds they are dorsally somewhat sharply rounded.

P_1 is 8 mm. long with 20 segments, of which the first three are not so long as broad with the corners cut away and those following are about as long as broad, gradually becoming elongate, and distally about twice as long as broad. This pinnule is considerably longer and stouter than those following. It is stout basally, tapering gradually to a slender and delicate tip. On the outer side of the postradial series it is sharply flattened exteriorly.

The next three pinnules, P_2, P_3, and P_4, are 6 mm. long with 15 segments most of which are about as long as broad, the basal two or three rather shorter, the distal rather longer. The pinnules following are of the same length but rather broader and more sharply carinate, distally becoming rather longer though remaining comparatively stout. The distal pinnules are 9–10 mm. long with the first segment rounded-triangular, concave distally, the second squarish, and the remainder longer than broad becoming about twice as long as broad distally.

The disk is scantily plated, except along the ambulacra, but the brachial and pinnule ambulacra are well plated. Sacculi are abundant on the brachial and pinnule ambulacra.

The color in alcohol is yellowish brown, and the containing liquid is stained the same color.

Notes.—The original description of *Antedon aster* was entirely inadequate and misleading. I wrote:

> This species is nearest to *Antedon quinquecostata* Carpenter (=*A. conifera* Hartlaub), of which I have 7 Japanese examples [=*Stenometra diadema*] for comparison; but the cirri are shorter and proportionately stouter, with 35–40 joints, the radials [i. e., IBr series] and brachials are rounded and not compressed, the former with their edges armed with fine teeth, the distal brachials strongly overlapping, the distal half as well as the distal edge of each joint beset with numerous fine teeth.
>
> Color in life bright yellow.

The locality was given as *Albatross* station 5088.

In the specimen from Dr. Mortensen's station 25 the centrodorsal is conical, 4 mm. broad at the base and 4 mm. high, with the free parts beset with fine spinelets. The cirrus sockets are arranged in 10 columns, the two in each radial area separated by a bare region. The cirrus sockets are not sculptured. The cirri are XXIII, 50–64, 32–42 mm. long. The IIBr series are 2. The 20 arms are 90 mm. long. The distal intersyzygial interval is 5–8 muscular articulations. P_1 is 9 mm. long with 24 segments. P_2 is 7.5 mm. long with 18 segments. P_3 is 6.5 mm. long with 16 segments. The distal pinnules are 9.5 mm. long with 21 segments. The disk is incised, almost naked, 7–10 mm. in diameter. The anal funnel is 3.5 mm. long, inserted in the right side of the anal interradius.

In a specimen from Mortensen's station 15, as described by Gislén, the centrodorsal is a low cone 1.8 mm. high. The cirri are XXVI, 39–47, 20–30 mm. long; the longest segment is half again as long as broad. The 17 arms are 65 mm. long. The IIBr series are 2. The radials are 10 times as broad as long. The IBr_1 is four times as broad as long. The IBr_2 (axillary) has a moderate synarthrial backward projection and, like the IBr_1, an insignificant median carination. All the ossicles are bordered with fine spinelets, in the distal parts of the arms covering the distal half of the brachials and the weak middorsal carination. The proximal portions of the arms are rounded. The intersyzygial interval is 4–6 muscular articulations. P_1 is 3.7 mm. long with 12 segments. P_2 is 2.5 mm. long with 9 segments. P_3 is 1.5 mm. long with 7 segments. The distal pinnules are 7 mm. long with 11–13 segments and are thickly beset with fine spinelets. The disk is strongly incised; the larger diameter is 6 mm. and the smaller 2.5 mm. There are sparse granules along the ambulacral furrows. The anal cone is 1.8 mm. high.

In another specimen from Mortensen's station 15 the cirri are broken. The 15 arms are 65 mm. long. P_1 is 4.5 mm. long with 14 segments.

Localities.—*Albatross* station 5088; Sagami Bay, Japan; Joka Sima Light bearing S. 65° E., 7.7 miles distant (lat. 35°11′25″ N., long. 139°28′20″ E.); 675–740 meters; green mud; bottom temperature 5.44° C.; October 25, 1906 [A. H. Clark, 1907, 1908, 1909, 1912, 1918] (1, U.S.N.M., 22636).

Sagami Bay; off Misaki; yacht *Golden Hind*, Alan Owston, June 1903 [A. H. Clark, 1908, 1909, 1911, 1912, 1918; H. L. Clark, 1916] (1, U.S.N.M., 22696 [original No. 8141]).

Sagami Bay; off Okinose; 730 meters; yacht *Golden Hind*, Alan Owston, March 1900 [A. H. Clark, 1908] (1, U.S.N.M., 48497 [original No. 6679]).

Dr. Th. Mortensen's Pacific Expedition 1914–16 station 25; Sagami Bay; off Okinose; 183 meters; hard bottom; June 26, 1914 [Gislén, 1924, 1927, 1934].

Dr. Th. Mortensen's Pacific Expedition 1914–16 station 15; Sagami Bay; 730 meters; June 1–7, 1914 [Gislén, 1924, 1937, 1934].

Geographical range.—Known only from Sagami Bay, Japan.

Bathymetrical range.—From 183 to 730 (?740) meters.

Thermal range.—One record, 5.44° C.

History.—This species was originally described in 1907 under the name *Antedon aster* from a specimen that had been dredged at station 5088 in Sagami Bay, Japan, by the *Albatross* in 1906. Later in the same year *Antedon aster* was referred to the new genus *Thalassometra.* In 1908 another specimen of *Thalassometra aster* was recorded from off Okinose, Sagami Bay, and at the same time a very fine example from off Misaki was described under the name of *Thalassometra komachi.* Both of these had been dredged by Alan Owston in his yacht the *Golden Hind.* They formed part of the large collection of crinoids purchased from Mr. Owston by Frank Springer and deposited in the United States National Museum. In 1909 *Thalassometra komachi* was referred to the new genus *Cosmiometra.*

Further study had shown that *Cosmiometra komachi* was merely a fully grown example of the species originally described as *Antedon aster* and in 1915 this form was listed as *Cosmiometra aster*, under which name it has since appeared.

In 1914 Dr. Th. Mortensen had dredged three specimens of this species in Sagami Bay, two small ones at station 15 and a larger one at station 25. Dr. Torsten Gislén figured an articulation of a distal pinnule of one of these in 1924, and recorded and gave notes on all three in 1927.

COSMIOMETRA PHILIPPINENSIS A. H. Clark

PLATE 5, FIGURE 16; PLATE 6, FIGURE 22

Cosmiometra philippinensis A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 548 (description; *Albatross* station 5523; also station 5424); Crinoids of the Indian Ocean, 1912, p. 215 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 153 (in key; range), p. 155 (synonymy; detailed description; Stations 95, 253, 254), pp. 272, 274 (listed), pl. 23, fig. 61.

Cosmiometra helene A. H. CLARK, Zool. Anz., vol. 39, No. 11/12, 1912, p. 427 (description; *Siboga* station 253); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 155 (identity).—H. L. CLARK, Biol. Res. Fish. Exper. F. I. S. *Endeavour*, 1909–14, vol. 4, 1916, pt. 1, p. 26 (comparison with *C. dasybrachia*).

Diagnostic features.—A moderately slender species with 20 arms; the cirri, which are arranged in 10 definite columns on a conical centrodorsal, are in general about one-third the length of the arms; and the elements of the division series and first two brachials have the median third smooth and the lateral thirds finely spinous or tubercular. The arms are 100–130 mm. long, and the cirri, which are rather stout, are 35–47 mm. long with 45–61 segments.

Description.—The centrodorsal is conical, about 4 mm. broad at the base and 4 mm. long. The cirrus sockets are arranged in 10 columns, 2 to each radial area, with 2 or 3 sockets to a column. The columns in each radial area are separated in the midradial line by a broad bare more or less finely spinous area which is about equal in width to a column of cirrus sockets. Outwardly the columns of cirrus sockets are in close apposition with those of the adjacent radial areas.

The cirri are XX, 45–54 (the longer 49–54), from 35 mm. to 42 mm. in length, and stout. The first segment is short, and those following gradually increase in length to the fourth, which is about twice as broad as long, and the fifth, which is about half again as broad as long. The sixth is a transition segment, from half again to twice as long as broad. The following segments gradually decrease in length, becoming about as long as broad at about the eleventh and twice as broad as long after the fifteenth. After the eighth or ninth the distal dorsal edge of the segments becomes slowly prominent so that the segments after the fifteenth or sixteenth are provided with a high and prominent dorsal spine as in the other species of the genus.

The ends of the basal rays are visible as small but prominent tubercles in the angles of the calyx.

The radials are concealed by the centrodorsal, or just visible in the midradial line. The IBr_1 are more or less crescentic, convex proximally, about 4 times as broad as long, with finely serrate edges and with the lateral two-thirds of the dorsal surface finely spinous. The IBr_2 (axillaries) are broadly pentagonal or rhombic, with blunted lateral angles, twice as broad as long, with the edges finely serrate and the dorsolateral edge bearing a few small spines. The IIBr series are 2. The division series and first brachials are sharply flattened laterally.

The 19 arms in the type specimen are 130 mm. long. The first brachials are slightly wedge-shaped, about twice as broad as long exteriorly. The second brachials are similar, but nearly twice as large. The first syzygial pair (composed of brachials $3+4$) is oblong, half again as broad as long. The following 6 brachials are approximately oblong, about two and one-half times as broad as long, then becoming very obliquely wedge-shaped, half again as broad as long, toward the middle of the arm as long as broad, distally less obliquely wedge-shaped, and terminally longer than broad. The arms increase slightly in width to the twelfth or fourteenth brachials, then slowly taper distally. The proximal third of the arm is very deep and strongly compressed laterally; the outer two-thirds is rather sharply rounded dorsally. After the oblong proximal brachials the distal ends of the brachials begin to project as a serrate overlap which characteristically in the outer half of the arms becomes very pronounced and is accompanied by a fine spinosity of the dorsal, but not lateral, surface.

The pinnules are essentially as in *C. aster*.

The color is bright yellow.

Notes.—Of the three specimens from *Albatross* station 5424 two have 19 and one has 20 arms from 100 to 110 mm. long; the cirri are 35–40 mm. long. These are somewhat smaller and more delicate than the type specimen from *Albatross* station 5523, described above, with slightly more projecting edges on the elements of the division series and proximal brachials.

The specimen from *Siboga* station 95 is young with 13 arms 45 mm. long and the longest cirrus 21 mm. long with 40 segments.

One of the specimens from Menado Bay, Celebes, has 19 arms. The midradial areas on the centrodorsal are triangular with the surface smooth and hollowed, the curved proximal border exposing the spinous surface of the radial. At the rim of the centrodorsal these bare midradial areas are twice the width of the adjacent cirrus sockets, the converging sides coming to a point between the apical cirri. The cirri are XXXV, 52–55, rather stout. The ornamentation on the sides of the IBr series is composed largely of prominent isolated low tubercles. A similar specimen has 20 arms; the cirri have 58–61 segments. In some of the specimens the bare radial areas on the centrodorsal are narrow, their basal width less than that of a cirrus socket, and short, while in others they are broad. Some have the lateral ornamentation on the division series entirely spinous, while in others it is more or less tubercular.

The specimen from *Siboga* station 253 was described as a new species, *Cosmiometra helene,* in the following terms. The centrodorsal is moderate in size, truncated conical, about 4.5 mm. broad at the base and about 2.5 mm. high interradially. The cirrus sockets are arranged in 10 columns of 2 or 3 each; interradially the columns are in close apposition, but in the midradial line they are separated by a wedge-shaped area, at first about as broad as a cirrus socket, but with converging sides that come together just beyond the last cirrus sockets; this bare midradial area is entirely covered with fine, more or less sharp, granulations. The dorsal pole is irregular, 2 mm. in diameter.

The cirri are moderately stout, 37–47 mm. long with 52–61 segments of which the first four are very short, the fifth is over twice as broad as long, the sixth, a transition segment, is half again as long as broad, and the seventh is slightly longer than the sixth. The segments following gradually decrease in length, becoming about as long as broad on the thirteenth, twice as broad as long on the twentieth, and shorter distally. Dorsal processes begin on the thirteenth and gradually increase in height. The dorsal spines are high and strongly carinate, V-shaped in end view, the two distal edges finely serrate. At the tip of the cirri they become narrower and smooth.

The radials are entirely concealed. The IBr_1 are short, about four times as broad as the lateral length, slightly convex proximally, distally incised by a rounded process from the axillary so that the median length is only about two-thirds of the lateral. The proximal border is armed with very numerous fine short spines. The distal border is similarly modified, but the spines become more-or-less obsolete in the median third. The lateral borders are similarly modified, but the spines extend farther inward over the dorsal surface of the ossicle and are more developed. The lateral thirds of the dorsal surface of the IBr_1 are rather thickly covered with fine short spines. The IBr_2 (axillaries) are rhombic, somewhat over twice as broad as long, with the lateral angles truncated. The lateral sides, formed by the truncation of the lateral angles, are only about one-third as long as the sides of the IBr_1. The proximal borders are modified like the corresponding borders of the IBr_1. The distal borders are very finely spinous.

The lateral fourths of the dorsal surface are covered rather thickly with fine short spines like the lateral thirds of the IBr_1. The synarthrial tubercles are low and only slightly marked. The division series are only slightly convex dorsally, sharply flattened laterally, and in very close apposition. The IIBr series are 2, the component ossicles resembling those of the IBr series, but with the proximal and distal borders more finely spinous and the spinous modification of the lateral portion of the dorsal surface relatively narrower exteriorly and very narrow interiorly.

The 20 arms are from 95 to 100 mm. long. The spinous modification of the lateral portion of the dorsal surface of the ossicles of the division series runs up in a very narrow and progressively narrowing band both internally and externally as far as the third or fourth brachial. The proximal oblong brachials have very slightly everted edges. As the brachials become triangular serrate longitudinal striations appear, first only in the median line, but soon over the entire dorsal surface of the brachials, which have slightly overlapping and spinous distal edges.

The specimen from *Siboga* station 254 is similar to that from station 253 just described. There are 20 arms about 95 mm. long. The cirri have 56–60 segments and are 35–40 mm. long.

Of the three specimens from the Danish Expedition to the Kei Islands station 12 one has 19 arms about 100 mm. long and the longest cirri 45 mm. long with 59 segments. The two others have 20 arms about 100 mm. long.

The specimen from the Danish Expedition to the Kei Islands Station 56 has 20 arms 105 mm. long. The longest cirri have 53–59 segments.

Localities.—Albatross station 5424; Joló (Sulu) Sea; Cagayan Island (S.) bearing S. 11° W., 3.4 miles distant (lat. 9°37′05″ N., long. 121°12′37″ E.); 621 meters; bottom temperature 10.2° C.; coral sand; March 31, 1909 [A. H. Clark, 1911, 1912; H. L. Clark, 1916] (3, U.S.N.M., 35597).

Albatross station 5523; in the vicinity of northern Mindanao; Point Tagolo Light bearing S. 48° W., 6.7 miles distant (lat. 8°48′44″ N., long. 123°27′35″ E.); no further data; August 10, 1909 [A. H. Clark, 1911, 1912; H. L. Clark, 1916] (1, U.S.N.M., 27497).

Siboga station 95; northwest of the Tawi Tawi Islands, Sulu (Joló) Archipelago (lat. 5°43′30″ N., long. 119°40′00″ E.); 522 meters; stony bottom; June 26, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Menado Bay, northern Celebes (lat. 1°31′ N., long. 124°47′ E.); 457 meters; Capt. H. Christiansen, Great Northern Telegraph Company, March 12, 1913 (8, U.S.N.M., E. 3214; C. M.).

Siboga station 253; Kei Islands (lat. 5°48′12″ S., long. 132°13′00″ E.); 304 meters; gray clay, hard and crumbly; December 10, 1899 [A. H. Clark, 1912, 1918] (1, Amsterdam Mus.).

Siboga station 254; Kei Islands (lat. 5°40′ S., long. 132°26′ E.); 310 meters; fine gray mud; December 10, 1899 [A. H. Clark, 1918] (1, U.S.N.M., E. 454).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 12; 320 meters; sand; April 9, 1922 (3, U.S.N.M., E. 3145; C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 56; 245 meters; May 10, 1922 (1, C. M.).

Geographical range.—From the Philippine Islands south to Celebes and the Kei Islands.

Bathymetrical range—From 245 to 621 meters; the average of seven records is 397 meters.

Thermal range.—One record, 10.2° C.

History.—This species was originally described under the name of *Cosmiometra philippinensis* from a single specimen from *Albatross* station 5523. I wrote that it is most closely related to *C. komachi* (=*aster*) from southern Japan, but the division series and oblong lower brachials are smooth, without the broadly everted and roughened edges and the rounded median linear tubercles of the latter, and the bare midradial areas on the centrodorsal are much broader. I said that both these species are related to *C. woodmasoni* which, however, appears to differ in the greater compression of the division series and consequent apparent narrowness of the lower part of the animal, and in the shortness of its cirri, which are said to have 35–45 segments, though figured with 35 (fig. 1) and 50 (figs. 2, 3). Three additional specimens from *Albatross* station 5424 were recorded, and notes on these were given.

In 1912 I described as a new species *Cosmiometra helene* from *Siboga* station 253. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 I placed *C. helene* in the synonymy of *C. philippinensis* which I recorded from stations 95, 253, and 254, giving notes on the specimens.

COSMIOMETRA CONIFERA (Hartlaub)

PLATE 3, FIGURES 10, 11; PLATE 4, FIGURE 15

[See also vol. 1, pt. 1, fig. 366, p. 297; pt. 2, fig. 213, p. 155; figs. 843–848, p. 405.]

Antedon conifera HARTLAUB, Nachr. Ges. Göttingen, May 1890, pp. 169, 173 (description; Japan); Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 76 (detailed description and comparisons; Japan, deep water), pl. 4, fig. 46; pl. 5, figs. 51, 56.—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 145 (considered as a synonym of *A. quinquecostata*); vol. 34, 1908, p. 466 (listed); vol. 43, 1912, p. 384 (=*Cosmiometra conifera*); Crinoids of the Indian Ocean, 1912, p. 37 (identity).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 309 (systematic position; history).

Stenometra conifera A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 15 (listed).

Cosmiometra conifera A. H. CLARK, Vid. Medd. Naturhist. Foren. København, 1909, p. 186 (allied to *C. crassicirra*); Proc. U. S. Nat. Mus., vol. 43, 1912, p. 384 (identity), p. 404 (Japan); Crinoids of the Indian Ocean, 1912, p. 37 (identity), p. 214 (synonymy; locality); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 154 (in key; range; references).—GISLÉN, Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Diagnostic features.—A species with 20 arms in which the elements of the division series and first two brachials are entirely smooth dorsally; and the cirri, which are arranged in 10 definite columns on a conical centrodorsal, are long and slender, slightly more than half as long as the arms, with about 70 segments. The arms are about 70 mm. long, and the cirri are 45 mm. long.

Description.—The centrodorsal is conical with a moderately broad stellate base the five angles of which are interradial and are produced ventrally. There are about 40 cirrus sockets which are arranged in 10 columns of 4 each. The columns are separated by rather low radial and interradial ridges of which the interradial run to the angles of the pentagonal base. The 10 ridges are of equal height and size, but the radial are slightly broadened at the lower end.

The cirri are about XL, about 70, about 45 mm. long. They are moderately stout and only slightly tapering. They are somewhat compressed laterally and when dry have the appearance of ivory. The first 5 or 6 segments are short, the next longer than broad, and the 3 or 4 following about as long as broad. The remainder are shorter, especially toward the end of the cirri. When viewed from the side the cirri have a deeply serrate dorsal profile from about the fifteenth segment on, resulting from the presence of dorsal tubercles. There are no true spines except on the penultimate segment.

The radials are plainly visible in the interradial angles. The IBr$_1$ are short and are entirely united laterally. The IBr$_2$ (axillaries) are rhombic. The IIBr series are 2. The division series and first brachials have sharply flattened sides.

The 20 stout arms, which have an uneven dorsal surface, are probably about 70 mm. long. The first brachials are short, rhombic, and laterally united interiorly. The second brachials are a good deal longer than the first and are longer exteriorly than interiorly. The first syzygial pair (composed of brachials 3+4) is approximately as long as broad. The following 6 or 7 brachials are bluntly wedge-shaped, and then comes a series of triangular brachials of which the distal edge overlaps the base of the brachial following with alternating lateral processes. Farther out the brachials become wedge-shaped again, finally becoming more and more oblong. All the brachials with the exception of the first two have produced and overlapping finely serrate distal edges. The distal portion of the arm has a sharp dorsal longitudinal carination.

Syzygies occur between brachials 3+4, again from between brachials 19+20 to between brachials 26+27 (usually between brachials 26+27), and distally at intervals of 4–8 muscular articulations. The syzygial unions are not smooth exteriorly, but are almost the same as the muscular articulations.

P$_1$ and P$_a$ are slender and taper rapidly from the somewhat broadened basal segments; they are about 11 mm. long with 15–20 segments the majority of which are elongated and cylindrical. The pinnules of the three following pairs decrease gradually in length. The smallest pinnule is P$_d$, which is only 4 mm. long. The segments of these pinnules are flatter and broader than those of the pinnules of the first pair (P$_1$ and P$_a$). The following pinnules reach a length of 11 mm. and are remarkable for their broad flat segments.

The ambulacral groove of the pinnules is provided with well-developed side and covering plates. Sacculi are few and small.

The disk is 14 mm. in diameter.

The skeleton is brownish white, the disk dark brown.

Notes.—As Dr. Hartlaub said, the type specimen is badly broken. All the arms and cirri are broken off, and in general the pinnules are not preserved. Only the proximal portion of the animal and the arm bases are well preserved. I have examined the type specimen, which was well described by Hartlaub.

Locality.—Japan; Dr. Franz Martin Hilgendorf: Dr. Hilgendorf told Dr. Hartlaub personally that according to his recollection the specimen came from deep water [Hartlaub, 1890, 1891; A. H. Clark, 1907, 1909, 1912, 1915, 1918; Gislén, 1934] (1, Berl. Mus., 2830).

History.—This species was described under the name of *Antedon conifera* by Dr. Clemens Hartlaub in 1890, and was redescribed and figured in the following year.

Hartlaub said that of the other species of the *Spinifera* group it comes nearest *Antedon* (*Stenometra*) *quinquecostata* Carpenter. Like that species it is characterized by a large number of cirrus segments and a definite arrangement of the cirri. He said that in *quinquecostata* the centrodorsal is more columnar and the cirri are not arranged in 10 columns but in 5 double columns, the 5 double columns being separated by 5 especially high ridges instead of the 10 ridges seen in *conifera*. But the most important difference is that the arms of *quinquecostata* have a sharp middorsal keel which in *conifera* is observable only on the outermost ends of the arms.

In 1907 I placed *Antedon conifera* in the synonymy of *A. quinquecostata*, of which I said I had seven Japanese specimens. These Japanese specimens represent in reality *Stenometra diadema* (see page 18). Just why I should have considered *conifera* a synonym of the very different *quinquecostata* I cannot now recall. In 1909 I transferred *conifera* to the genus *Stenometra*, and later in the same year to *Cosmiometra*. In 1912 I mentioned that I had examined the type specimen of *Antedon conifera*, but gave no additional information regarding it. Everything we know concerning this species is included in the original description.

COSMIOMETRA CRASSICIRRA (A. H. Clark)

Plate 10, Figure 33

Thalassometra crassicirra A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 214 (in key), p. 225 (description; *Albatross* station 3882; the specimen from station 4107 is the type specimen of *Stiremetra decora*).

Cosmiometra crassicirra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 17 (listed); Vid. Medd. Naturhist. Foren. København, 1909, p. 186 (allied to *C. conifera*); Crinoids of the Indian Ocean, 1912, p. 215 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 154 (in key; range; references).—Gislén, Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.—A. H. Clark, Bernice P. Bishop Mus. Bull. 195, 1949, p. 74 (*Albatross* station 3882), p. 93 (station data).

Diagnostic features.—A species with 20 arms in which the elements of the division series and first two brachials are entirely smooth dorsally, and the cirri, which are irregularly arranged in 1, 2, or 3 columns in the several radial areas of the short columnar or almost discoidal centrodorsal, are moderately slender, about one-third of the arm length, with 50–54 segments. The arms are 130 mm. long, and the cirri are 45 mm. in length.

Description.—The centrodorsal is broad, short columnar or almost discoidal, with the cirrus sockets arranged in 1, 2, or 3 columns in each radial area. One of the radial areas has 2 marginal columns of cirrus sockets separated by a median space nearly as wide as the cirrus sockets themselves, 3 of the radial areas have 3 columns of cirrus sockets, and the remaining radial area has a single median column of cirrus sockets. There are 1 or 2 cirrus sockets in each column. The broad and flat dorsal pole and the sides of the centrodorsal where there are no cirrus sockets are very rough.

The cirri are XVII, 50–54, 45 mm. long, moderately slender. The first 4 segments are short, the fifth is about as long as broad, and those following to the fourteenth or sixteenth are about half again as long as broad. The sixteenth is a transition segment; it is but little longer than broad; the distal half or third has a polished surface, the proximal half or two-thirds a dull surface. The next few segments after the transition segment are slightly broader than long, and those succeeding gradually become shorter.

All the segments from the transition segment onward bear prominent dorsal spines which on the 3 or 4 terminal become very small. The opposing spine is low, less than one-fourth the width of the penultimate segment in height, and rounded. The terminal claw is longer than the penultimate segment, stout, and moderately curved.

The disk is naked, except for a few scattered granules near the periphery. The brachial ambulacra are naked. The pinnule ambulacra have moderately developed side and covering plates. The sacculi are small.

The ends of the basal rays are visible as irregular tubercles in the interradial angles of the calyx.

The radials are concealed by the centrodorsal. The IBr_1 are almost entirely concealed, but their apposed sides are visible as triangles in the interradial angles. The IBr_2 are rhombic, about twice as broad as long, produced posteriorly over the IBr_1, with the borders slightly prominent and a moderately sharp median keel. The IIBr series are 2, with the axillary rhombic and over twice as long as the preceding ossicle; both are bluntly carinate in the median line, and their borders are slightly prominent. The division series are sharply flattened laterally and are in close lateral apposition. The first 15 brachials are also sharply flattened laterally.

The 20 rather slender arms are 130 mm. in length. The first 2 brachials are wedge-shaped, the latter larger than the former and with a rounded posterior projection. The following 11 brachials are oblong or slightly wedge-shaped, about twice as broad as long, those succeeding gradually becoming somewhat more obliquely wedge-shaped, about as long as broad, and slowly less obliquely wedge-shaped distally, and elongate terminally. After about the proximal third of the arm the brachials develop prominently overlapping distal edges which are armed with fine spines. The arms are strongly compressed laterally in the basal third, and moderately compressed distally.

Syzygies occur between brachials 3+4, again between brachials 23+24 and 32+33 and distally at intervals of from 4 to 9 muscular articulations, the intersyzygial interval decreasing distally.

P_1 is 7 mm. long, considerably stouter than P_2 though not especially enlarged, tapering evenly from the base to the tip. It is composed of 15 segments all of which are about as long as broad, P_2 is 5 mm. long with 13 segments of which the first is about as long as broad and those following become progressively elongated, reaching a length of 2 or 3 times the width distally. The following pinnules gradually decrease in length to P_6 or P_7, then become rather more slender and increase to 7 mm. distally.

The color in alcohol is brownish yellow, the calyx and arm bases to the fourth brachial dark brown, the cirri light yellowish.

Locality.—Albatross station 3882; Hawaiian Islands; Pailolo Channel, between Maui and Molokai; Mokuhooniki Islet bearing N. 30° W., 3.1 miles distant; 249 meters; sand, coral, and rock; bottom temperature 17.5° C.; April 16, 1902 [A. H. Clark, 1908, 1909, 1912, 1918, 1949; Gislén, 1934] 1, U.S.N.M., 22689).

History.—This species was described under the name of *Thalassometra crassicirra* in 1908 from a single specimen from *Albatross* station 3882; at the same time another small 10-armed specimen from station 4107 was recorded which is regarded herein as the type specimen of *Stiremetra decora* (see page 134). In 1909 *crassicirra* was removed to the new genus *Cosmiometra.* It has not been rediscovered since it was originally described.

COSMIOMETRA WOODMASONI (Bell)

Antedon wood-masoni Bell, Journ. Linn. Soc. (Zool.), vol. 24, No. 154, May 5, 1893, p. 340 (description; Sahul Bank), pl. 23; pl. 24, fig. 1.—[Bell], Crustacea, Echini, Peripatus, Worms, and Anthozoa, 1906, p. 747.

Thalassometra wood-masoni A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed).

Cosmiometra woodmasoni A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 17 (listed); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 549 (compared with *C. philippinensis*); vol. 40, 1911, p. 38 (compared with *C. gardineri*); Mem. Australian Mus., vol. 4, 1911, p. 795 (synonymy; Sahul Bank); Crinoids of the Indian Ocean, 1912, p. 214 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 44 (published reference to specimen in the B. M.; locality; comparison with *C. crassicirra*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 154 (in key; range), p. 155 (references).

Diagnostic features.—A species with 20 arms in which the elements of the division series and first two brachials are entirely smooth dorsally with a narrow and moderately high median carination and the lateral edges not produced; and the short and rather stout cirri have 40–41 segments. The arms are 110 mm. long, and the cirri are 27 mm. in length.

Description.—Professor Bell's description of this species is as follows:

> This new species belongs to Carpenter's *Spinifera*-group; that is, it is bi-distichate [with the IIBr series 2] and has some of the basal joints more or less wall-sided. As it has more than thirty cirrus-joints, the more distal of which are spiny, the first pinnule as long as or longer than the second, and the cirri not arranged in rows on the centro-dorsal, it stands nearest to *A.* [*Horaeometra*] *duplex* (P. H. C. MSS) and *A.* [*Stiremetra*] *lusitanica.* The former of these has from 30–40 cirrus joints, the latter 50; the present would appear to have from 35 to 45; the radial axillaries [IBr$_2$] are short and wide as in *A. lusitanica,* and there is no noticeable expansion of any of the joints of the pinnules.
>
> The following may serve as a specific diagnosis:
>
> A member of the *Spinifera* group, and falling under the same subdivision as *A. duplex* and *A. lusitanica.* Centrodorsal rather large, but not columnar, the central portion free of cirrus-sockets; about 18 [XVIII] cirri, with 35–45 joints; these begin to be spiny at about the tenth joint, and the spine, though not large, is quite well marked. First radials [radials] hidden, the second [IBr$_1$] much wider than long, slightly concave on its distal side; the axillaries [IBr$_2$] wide, with two slight concavities for the reception of the first distichal [IIBr$_1$], which again is much wider than long; the distichal axillary [IIBr$_2$] of much the same shape as the radial [IBr$_2$]; the two visible radials [ossicles of the IBr series] and the distichals [IIBr series] have a median linear tubercle.
>
> 20 arms. Basal joints with fairly regular sides; the third a syzygy [a syzygy between brachials 3+4]; then one, ordinarily, on the 12th [between brachials 13+14] or 14th [between brachials 15+16] joints. The arm-joints gradually become triangular, flattened from side to side, and provided with a median ridge. The pinnules are styliform, but short and with simple joints; they increase somewhat in length nearer the end of the arm.
>
> Diameter of disk 6 millim. Length of arms 110 millim.
>
> Colour white, with faint patches of brown here and there.

I examined the type specimen at the British Museum in London in 1910. The arms are 110 mm. long, and the cirri are comparatively short and stout, 27 mm. long with 40–41 segments of which the seventh is a transition segment. In my notes I wrote that in general this species resembles *C. crassicirra* from the Hawaiian Islands; the division series are strongly, but roundedly, carinate. In my diagnosis of *Cosmiometra gardineri* I said that it is closely related to *C. woodmasoni,* but the cirri are shorter and stouter, with proportionately shorter segments; the carination of the division series is narrower, and the lower brachials have only a faintly indicated crest; the distal brachials are overlapping and narrowly carinate. In my description of *Cosmiometra philippinensis* in 1911 I noted that this species differs from it in the greater compression of the division series and consequent apparent narrowness of the lower part of the animal, and in the shortness of the cirri.

Locality.—Sahul Bank, south of the southern end of Timor (lat. 11°30′ S., long. 125° E.); from a cable [Bell, 1893 ("Sahul Bank, North Australia"), 1906; A. H. Clark, 1907, 1909, 1911, 1912, 1913, 1918] (1, B. M.).

History.—This species was originally described under the name of *Antedon wood-masoni* by Prof. F. Jeffrey Bell in 1893 from two or more specimens that had been found attached to a cable crossing the Sahul Bank (see under *Asterometra mirifica*, Part 4b, p. 434). Professor Bell did not give the number of specimens, but said that the species was represented in the British Museum and in the Indian Museum at Calcutta. In a guide to a portion of the invertebrate exhibits published in 1906 Professor Bell mentioned this species, so the British Museum must possess at least two.

In 1907 I placed *wood-masoni* in the new genus *Thalassometra*, and in 1909 transferred it to the new genus *Cosmiometra*. In 1910 I examined the single specimen (the type) in the study collection of the British Museum, but overlooked the specimen or specimens in the exhibition hall. In 1911 I compared this species with the new species *Cosmiometra philippinensis*, and in another paper published in the same year with the new species *C. gardineri*. In my memoir on the Recent crinoids of Australia published in 1911 *Cosmiometra woodmasoni* was included and the synonymy was given. In my memoir on the crinoids of the Indian Ocean published in 1912 I published notes on the type specimen in the British Museum, and compared it with the Hawaiian *C. crassicirra*. I did not find any specimen of this species in the Indian Museum collection. My notes on the type specimen were republished in a paper on the crinoids of the British Museum in 1913. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *woodmasoni* was included in a key to the species of *Cosmiometra*, together with its range, and the synonymy was given.

COSMIOMETRA IOLE, sp. nov.

PLATE 4, FIGURE 14

Diagnostic features.—A species with 20 arms in which the elements of the division series and first two brachials are entirely smooth dorsally with a narrow and moderately high median carination and the lateral edges produced and slightly everted, broadly scalloped or bearing two or three blunt tubercles; the cirri, which are irregularly arranged on a large columnar centrodorsal are short and moderately stout with 29–35 segments. The arms are 100 mm. long, and the cirri are 25 mm. in length.

Description.—The centrodorsal is large, columnar with converging sides, the broad dorsal pole 3 mm. in diameter and thickly beset with papillae which tend to be arranged in radiating interradial lines. The cirrus sockets are very closely crowded and are irregularly arranged. Interradially the rim of the centrodorsal is raised into a high crest which reaches the everted lateral borders of the radials.

The cirri are XVII, 29–35, 25 mm. in length, and moderately stout. The first segment is very short, and those following slowly increase in length to the fifth, which is somewhat more than twice as broad as long. The sixth is about twice as long as broad and is a transition segment with the proximal three-quarters dull and the distal quarter whitish and highly polished. This segment is constricted, the maximum depth of the constriction being just before the polished distal portion. The seventh segment is about half again as long as broad, and the eighth is usually about one-third again as long as broad. The following segments decrease in length, those in the terminal fourth or fifth of the cirri being nearly twice as broad as long. The eighth segment has the dorsal portion of the distal edge very slightly produced and finely spinous. On the segments succeeding this production of the distal edge becomes narrower and higher and involves more of the dorsal surface, in the segments of the terminal portion of the cirri narrowing into a high dorsal spine with a rounded dorsal crest. The first cirrus segment commonly bears a small tubercle resembling those on the dorsal surface of the centrodorsal.

The ends of the basal rays are visible in the angles of the calyx as distinct tubercles, or as a continuation of the interradial crests on the centrodorsal.

The distal portion of the radials is visible as a narrow curved band just beyond the rim of the centrodorsal. The anterolateral angles are separated by a slight notch. and may be produced into a small high tubercle. The IBr_1 are narrow, four times as broad as long, with the proximal and distal borders parallel. The lateral edges are produced and slightly everted, and are broadly scalloped or bear two or three blunt tubercles. The proximal border may be either unmodified or slightly scalloped, and may bear a tubercle at or near the posterolateral angles. A conspicuous narrow median keel with the crest evenly convex in lateral view occupies the midline. The IBr_2 (axillaries) are low, three times as broad as long, with the lateral edges not very much shorter than those of the IBr_1. The distal edges are slightly and narrowly thickened, and the posterolateral angles are more or less produced and irregularly scalloped. A conspicuous narrow keel, of which the crest as seen in profile is straight, occupies the entire median line of the ossicle. The IIBr series are 2 and resemble the IBr series, but are proportionately slightly longer with the borders of the component ossicles less irregular. The proximal and distal borders are very slightly everted.

The 20 arms are 100 mm. long. They are narrow at the base and increase slowly in width up to the tenth or twelfth brachial, thence very gradually tapering distally. The first brachials are half again as long exteriorly as interiorly, and about twice as broad as the exterior length. The inner edges are slightly produced, forming flangelike margins which meet above the apex of the axillaries. There is a conspicuous narrow median keel. The proximal border is slightly and narrowly everted. The second brachials are slightly larger with the outer side slightly longer and the inner side shorter. They bear a conspicuous median keel, and the proximal and distal borders are slightly and narrowly everted. The first syzygial pair (composed of brachials 3+4) is from one-third to one-half again as broad as long. Both the hypozygal and the epizygal have a narrow median keel which is not so high as that on the brachials preceding. The next four brachials are slightly wedge-shaped, and are about three times as broad as the median length; each has a slight, but distinct, narrow median keel. The following brachials become very obliquely wedge-shaped, or almost triangular, not quite twice as broad as the greater length, and distally gradually less obliquely wedge-shaped and longer. Each brachial bears a low narrow median keel with a rounded crest. The distal edges of the brachials are slightly produced and finely spinous, the spines being most conspicuous at the end of the median keel In lateral view the dorsal profile of the arms is markedly serrate.

P_1 is 7 mm. long with 14 segments of which the first is very short, the third is slightly broader than long, the fourth is slightly longer than broad, and the last three or four are about twice as long as broad. The distal angles of the segments project considerably beyond the somewhat narrowed bases of the segments succeeding, giving the profile of the pinnule a strongly serrate character. Though stouter, as well as longer, than the following pinnules, P_1 is not appreciably enlarged.

P_2 is 5 mm. long with 10 segments, resembling P_1 but proportionately more slender. P_3 is 4 mm. long with 9 segments, and resembles P_2. P_4 is 3 mm. long with 8 segments. P_5 is similar to P_4. The pinnules succeeding slowly increase in length, reaching a length of 7.5 mm. distally.

Notes.—A young specimen taken with the one described has 14 arms 85 mm. long.

Locality.—Dr. Th. Mortensen's Pacific expedition, 1914–1916; 25 miles east by south from Zamboanga, Mindanao, Philippine Islands; 292–365 meters; hard bottom; March 3, 1914 (2, C. M.).

COSMIOMETRA GARDINERI A. H. Clark

Cosmiometra gardineri A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 6 (*Antedon carinata* recorded by Bell from South Africa possibly this species), p. 8 (southeastern Africa), p. 38 (description; Saya de Malha, 135 fathoms); Crinoids of the Indian Ocean, 1912, p. 41 (possible identity with *Antedon carinata* Bell, 1909), p. 214 (synonymy; Saya de Malha, 135 fathoms); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 43 (published references to the specimen in the B. M.; locality; characters; comparison with *C. woodmasoni*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 154 (in key; range; references); John Murray Exped., 1933–34, Sci. Reports, vol. 4, No. 4, 1936 (Jan. 1937), p. 101 (range), p. 104.

Diagnostic features.—A species with 20 arms in which the elements of the division series and first two brachials are entirely smooth dorsally with a low and broad median carination; the outer brachials are very strongly overlapping and broadly carinate; and the cirri are slender, 30 mm. long with 29–31 segments.

Description.—This species is closely related to *C. woodmasoni*. The cirri are longer and more slender, 30 mm. long with 29–31 segments, which are proportionately longer. There are 20 arms. The carination of the division series is broader than it is in *C. woodmasoni*. The lower brachials have a broad median keel quite different from the faintly indicated crest of *C. woodmasoni*, and the outer brachials are very strongly overlapping and broadly carinate, the raised portion, when viewed dorsally, having a triangular shape, the apex of the triangle being proximal; the same type of carination is found in *C. woodmasoni*, but the triangles are narrower.

Locality.—Saya de Malha, Indian Ocean; 247 meters; Percy Sladen Trust Expedition to the Indian Ocean in 1905, J. Stanley Gardiner, leader; *Sea Lark* [A. H. Clark, 1911, 1912, 1913, 1918, 1937] (1, B. M.).

History.—The type and only known specimen of this species was secured by the Percy Sladen Trust Expedition to the Indian Ocean on the *Sea Lark* under the leadership of Prof. J. Stanley Gardiner in 1905, but was not mentioned by Prof. F. Jeffrey Bell in his account of the echinoderms of that expedition published in 1909. It was described in 1911 in a paper on the crinoids of the coasts of Africa, and at the same time it was suggested that the *Antedon* (*Tropiometra*) *carinata* recorded by Bell from deep water off Saya de Malha might be this species. It was mentioned in my memoir on the crinoids of the Indian Ocean published in 1912, and was redescribed in my account of the crinoids of the British Museum published in 1913. It was inserted in the key to the species of *Cosmiometra* in my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 and the range and synonymy were given, and it was mentioned in my report on the crinoids of the John Murray Expedition to the Indian Ocean, 1933–34, published in 1937.

Genus **PARAMETRA** A. H. Clark

Antedon (part) P. H. Carpenter, *Challenger* Reports, Zool., vol. 26, pt. 60, 1888, p. 222, and following authors.

Charitometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361.

Thalassometra (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 125.

Parametra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 15 (diagnosis; genotype *Antedon orion* A. H. Clark, 1907); Amer. Journ. Sci., ser. 4, vol. 32, 1911, p. 129 (characteristic of the Japanese fauna; significance); Crinoids of the Indian Ocean, 1912, p. 9 (absent from Australia), p. 10 (occurs in the Hawaiian Islands), p. 11 (absent from the west coast of the Malay Peninsula, the Andamans, and farther west), p. 17 (significance of conditions in this genus in southern Japan), p. 24 (range), p. 59 (in key), p. 213 (original reference; genotype); Die Crinoïden der Antarktis, 1915, p. 125 (certain species of this genus show the characteristic features of *Anthometra adriani*).—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Pap. 90–L, 1915, p. 195 (inorganic constituents of the skeleton); U. S. Geol. Surv. Prof. Pap. 102, 1917, pp. 23 and following (same).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, pp. 146, 147, 148 (in key; range), p. 158 (key to the included species).—F. W. Clarke and W. C. Wheeler, U. S. Geol. Surv. Prof. Pap. 124, 1922, p. 20 (inorganic constituents of the skeleton).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8 (must be referred to the Charitometridae).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 649.—Gislén, Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20.

Diagnosis.—A genus of Thalassometridae in which the brachials beyond the basal are more or less compressed laterally and carinate or subcarinate, or at least strongly rounded dorsally; the division series, which are all 2, and arm bases are strongly rounded dorsally, slightly or not at all flattened against their neighbors, the individual ossicles plain, with everted edges, or with a more or less granular surface, usually with a delicate middorsal carinate line; and the brachial carination is not produced into overlapping spines. The 10–20 arms are 90–170 mm. long, and the short and rather stout cirri are 20–28 mm. long with 18–27 segments.

Geographical range.—From southern Japan and the Hawaiian Islands to the Philippines, the Moluccas, the Kei Islands, and Timor.

Bathymetrical range.—From 128 to 795 meters.

Thermal range.—From 10.78° to 15.89° C.

Remarks.—The genus *Parametra* is related to *Cosmiometra*, but it represents a more generalized type with the division series and brachials less specialized and the cirri short and stout with relatively few segments. The species of *Parametra*, with their short and stout cirri and the scarcely modified P_1, bear a considerable superficial resemblance to certain species in the family Charitometridae, and they have been erroneously referred to that family both by Gislén and by myself.

The six species of *Parametra* fall into two groups. In the first and more typical group, including *compressa*, *granulata*, *orion*, and *lisa*, the arms are carinate or subcarinate and P_1 resembles P_2 except for being longer and proportionately stouter. The species of the other group, *ajax* and *fisheri*, have the arms rounded dorsally and P_1 more or less enlarged in the basal portion, thus forming to a certain extent a transition between the genera of Thalassometridae with carinate arms, all the division series 2, and a scarcely modified P_1, and the genera with dorsally rounded arms, the IIBr series, if present, usually 4(3+4), and a much enlarged P_1.

History.—The first known species of this genus was described under the name of *Antedon compressa* by Dr. P. H. Carpenter in 1888. A second species was described as *Antedon orion* in 1907. In my first revision of the old genus *Antedon* published later in 1907 *compressa* and *orion* were both referred to the new genus *Charitometra*, but in a paper published on April 11, 1908, I said that "the species *compressa* and *orion*, placed in *Charitometra*, should have been referred to *Thalassometra*." Later in the same year (May 14) I described *Thalassometra fisheri*. In my revision of the family Thalassometridae published in January 1909 I established the genus *Parametra* with the genotype *Antedon orion* A. H. Clark, 1907, including in the new genus *compressa*, *fisheri*, and *orion*. *Parametra granulata* was briefly diagnosed in 1913.

In discussing the specimens of *Parametra granulata* and *P. compressa* in the British Museum in 1928 Prof. Torsten Gislén said that the genus *Parametra* must be referred to the Charitometridae, under which family he placed it. In 1934, however, he revised this opinion.

KEY TO THE SPECIES IN THE GENUS PARAMETRA

a^1. Arms carinate or subcarinate, at least with a low but distinct carinate line, never evenly rounded dorsally; cirri with the transition segment the eighth; P_1 evenly tapering.
  b^1. Distal cirrus segments broader than long with prominent carinate processes; cirri about one-fifth the arm length.
    c^1. Not more than 20 cirrus segments; usually 15–20 arms.
      d^1. Lateral portions of the division series and arm bases smooth; 15–20 arms 120–140 mm. long; cirri 23 mm. long with 16–20 segments (from the Timor Sea to the Kei Islands and north to Halmahera; 216–795 meters) ---------- **compressa** (p. 65)
      d^2. Lateral portions of the division series and arm bases more or less covered with fine tubercles; 12–20 (usually 17–20) arms 145–170 mm. long; cirri with 18 segments (Philippine Islands; 150–510 meters) ---------- **granulata** (p. 69)
    c^2. Cirrus segments 20–25 in fully developed individuals; usually 10–15 arms 125–140 mm. long (Hong Kong to southern Japan from the Korean Straits to Sagami Bay; 128–306 meters). **orion** (p. 72)
  b^2. Distal cirrus segments as long as broad with very small and obscure dorsal processes; cirri about one quarter of the arm length; 19 arms 115 mm. long, the cirri 20–28 mm. long with 25–26 segments (Kei Islands; 250 meters) ---------- **iisa** (p. 83)

a^2. Arms evenly rounded dorsally, the brachials with prominent or thickened distal ends; P_1 more or less swollen basally, not much longer than the more slender and evenly tapering P_2; cirri rather long and stout, about one quarter of the arm length, with the transition segment from the fifth to the eighth.
  b^1. Outer cirrus segments with a rather high transverse ridge with the crest flattened and dentate, on the last six becoming a low submedian dorsal tubercle; transition segment the sixth, seventh, or eighth; 20 arms about 90 mm. long; cirri 20–25 mm. long with 23–27 segments (Malay Archipelago) ---------- **ajax** (p. 84)
  b^2. Outer cirrus segments with prominent and sharp dorsal spines; transition segment the fifth; 13 arms 110 mm. long; cirri 20–25 mm. long with 19–26 segments (Hawaiian Islands; 351–643 meters) ---------- **fisheri** (p. 86)

PARAMETRA COMPRESSA (P. H. Carpenter)

PLATE 8, FIGURE 26

Antedon compressa P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 222 (description; *Challenger* station 192 [the specimen from station 201=*P. granulata*]), pl. 41, figs.

1–4.—Bell, Proc. Zool. Soc. London, 1894, p. 401 (comparison with *A. moorei*).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 309 (in *Spinifera* group; history).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 31 (of P. H. Carpenter, 1888=*Parametra compressa*); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 81 (of P. H. Carpenter, 1888=*P. compressa*+*P. granulata*).

Charitometra compressa A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 125 (should have been referred to *Thalassometra*).

Thalassometra compressa A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 125 (at first wrongly referred to *Charitometra*); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 225 (comparison with *Th.* [*Parametra*] *fisheri*; systematic position).

Parametra compressa A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 16 (listed); Crinoids of the Indian Ocean, 1912, p. 34 (=*Antedon compressa* P. H. Carpenter, 1888), p. 213 (synonymy; range, in part [excluding Philippine Islands]); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 45 (published references to specimens in the B. M.; *Challenger* station 192; characters of the division series and lower brachials); Unstalked crinoids of the *Siboga*-Exped. 1918, p. 158 (in key; range; references; detailed description; station 302), p. 276 (listed).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8, No. 33 (notes).

Diagnostic features.—The arms beyond the proximal more or less oblong brachials are distinctly carinate; the cirri are short, about one-fifth of the arm length, with the transition segment the eighth and the distal segments broader than long with prominent carinate processes or blunt dorsal spines; and the lateral portions of the elements of the division series and first two brachials are smooth. The 15–20 arms are 120–140 mm. long, and the cirri are 23 mm. long with 16–20 segments.

Description.—The centrodorsal is discoidal with a bare flat polar area 3.5 mm. in diameter.

The cirri are XIV, 18–20, 23 mm. long. The first segment is very short, those following gradually increasing in length to the fourth, which is slightly broader than long, and the fifth–seventh, which are as long as, or very slightly longer than, broad. The eighth, a transition segment, is about half again as long as the median width. The ninth is about as long as the median width. The following segments gradually decrease in length so that the last three or four before the penultimate are about twice as broad as long. The distal dorsal edge of the eighth is thickened; on the segments succeeding this thickening soon becomes a thick rounded dorsal spine of the type characteristic of the genus.

The ends of the basal rays are visible as small but prominent rounded tubercles in the angles of the calyx.

The radials are concealed. The IBr$_1$ are very short, about twice as long on the lateral border as in the median line, in lateral apposition for the basal two-thirds but in the distal third diverging in nearly a straight line, extending well up in the angles of the calyx; they bear a low blunt median carination. The IBr$_2$ (axillaries) are rhombic, twice as broad as long, the lateral angles in contact with those of their neighbors; the cutting away of the distal angles of the IBr$_1$ forms large and conspicuous water pores just beneath the apposed angles of the axillaries; in the median line of the axillaries there is a low blunt median carination; from the lateral angles a horizontal ridge runs inward for from one-third to one-half of the distance to the median line, sometimes in the middle of the angle, sometimes toward the proximal side, where it branches, one branch curving downward and becoming a produced proximal border which runs to the median carination, the other branch running as a thickened rim along the distal faces of the axillary, or as a ridge just within the distal edges, sometimes meeting just proximal to the distal apex, though usually forming a broad curve beyond which is the apex. The IIBr series are 2. The proximal and distal edges of the elements of the IIBr series are moderately thickened and everted; there is a slight rounded median carination; the axillaries have thickened distal edges and produced proximal edges, the latter running in a broad curve in the central part of the segment, in the lateral third or fourth running nearly or quite straight to the lateral angle.

The edges of the first two brachials are modified like those of the elements of the IIBr series; there is a trace of a median carination.

P_1 is 10–12 mm. long with 17–21 segments which, at first short, become about as long as broad on the sixth, and nearly twice as long as broad terminally. The pinnule is evenly tapering, rather strongly prismatic, and but little enlarged; the second–fifth segments are sharp distally, though not distinctly carinate; the outer segments have the distal angles rather prominent, though not produced. P_2 is 6.5 mm. long with 12 segments, shorter, more slender, and slightly less tapering than P_1. The pinnule is strongly and sharply prismatic, the profile of the prismatic angle on the outer segments being slightly convex; the distal segments have slightly prominent distal angles. P_3 is 6 mm. long with 12 segments, similar to P_2 but tapering slightly more rapidly distally. The following pinnules resemble P_3. The distal pinnules are slender, 9 mm. long with 17 segments.

Notes.—The preceding description is based upon the specimen from *Siboga* station 302. Carpenter's original description, based upon two specimens from *Challenger* station 192 and one from *Challenger* station 201 (the last representing *P. granulata*) was as follows:

The centrodorsal is a thick convex plate with the dorsal pole free.

The cirri are XV–XX, about 20; a few of the segments are longer than wide, and the latter are somewhat compressed laterally, with blunt dorsal spines.

The radials, and sometimes parts of the IBr_1, are concealed. The IBr_1 are short and sharply convex with a slight median ridge, and they meet one another laterally beyond the angles of the centrodorsal. The IBr_2 (axillaries) are short and widely rhombic, also with a median ridge, and forming a small tubercle with the preceding ossicles. The IIBr series are 2, with a faint median ridge; the axillaries are short and widely rhombic. The outer sides of the IBr axillaries, the elements of the IIBr series, and the first two brachials are slightly flattened, and the inner sides of the second brachials and the first syzygial pairs are also somewhat flattened.

The 15–20 arms are 140 mm. long and are composed of 150 or more brachials, of which the lowest are nearly oblong with indications of a dorsal keel and raised distal edges, and those following are more triangular and distinctly carinate, gradually becoming quadrate and somewhat compressed laterally, with a tendency to overlap.

Syzygies occur between brachials 3+4, again from between brachials 12+13 to between brachials 13+14, and distally at intervals of from 3 to 8 (usually 5 or 6) muscular articulations.

P_1 is about 10 mm. long with about 18 short segments, the first few of which are much wider than their successors and slightly prismatic. P_a is smaller, with the basal segments more rounded and not so wide. The following pinnules diminish in size to about the tenth brachial (P_5), having fewer but relatively longer segments. Beyond this point the length gradually increases again, and the later pinnules are slender and delicate, with the two basal segments flattened and somewhat expanded.

The disk is 8 mm. in diameter and is well plated along the ambulacra, but the interpalmar areas have only a few scattered granules; the brachial ambulacra and interarticular spaces are also well plated. The side plates of the pinnule ambulacra are fairly distinct, with intervening sacculi.

The color in alcohol is very light brown, the disk darker.

I examined the two specimens from *Challenger* station 192 during a visit to the British Museum in 1910. The carination on the earlier ossicles is confined to the axillaries and the second brachials and is rounded and inconspicuous; the lower brachials and the ossicles of the division series have rather strongly everted edges.

Dr. Torsten Gislén also examined these specimens. He noted that in one the cirri are XIV, 18–20, and in the other XIV, 19–20. They have a distinct dorsal longitudinal crest, and are arranged in 10 and 8 indistinct columns; there is a weak single opposing spine.

The specimen from the Danish Expedition to the Kei Islands station 4 has 12 arms 65 mm. long; the cirri have 17 segments.

The specimen from the Danish Expedition to the Kei Islands station 46 has 20 arms 120 mm. long, all the IIBr series being present; the cirri have 16–19 segments.

Localities.—*Challenger* station 192; near the Kei Islands (lat. 5°49′15″ S., long. 132°14′15″ E.); 256 meters; blue mud; September 26, 1874 [P. H. Carpenter, 1888; Bell, 1894; Hartlaub, 1912; A. H. Clark, 1907, 1908, 1909, 1912, 1913; Gislén, 1928] (2, B. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 4; 250 meters; sand; April 3, 1922 (1, C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 46; 250 meters; May 2, 1922 (1, C. M.).

Siboga station 302; Timor Sea (lat. 10°27′54″ S., long. 123°28′42″ E.); 216 meters; sand and coral sand; February 2, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Albatross station 5619; Molucca Passage; March Island (S.) bearing S. 78° E., 7 miles distant (lat. 0°35′00″ N., long. 127°14′40″ E.); 795 meters; fine gray sand and mud; November 27, 1909 (1, U.S.N.M., 36025).

Albatross station 5617; Dodinga Bay, Gillolo Island; Ternate Island (S. E.) bearing S. 45° W., 7 miles distant (lat. 0°49′30″ N., long. 127°25′30″ E.); 239 meters; November 27, 1909 (5, U.S.N.M., 35976).

Geographical range.—From the Timor Sea to the Kei Islands and northward to Halmahera (Gillolo).

Bathymetrical range.—From 216 to 795 meters; all but one of the six records are from between 216 and 256 meters.

History.—This species was originally described in 1888 by Dr. P. H. Carpenter under the name of *Antedon compressa* on the basis of two specimens from *Challenger* station 192 and one specimen together with fragments of a larger individual from station 201. The specimen from the latter station is herein referred to *Parametra granulata* (see page 69). Carpenter said that this species is in some respects a transitional form between *Antedon* (*Perissometra*) *patula* and *A.* (*P.*) *flexilis* on the one hand, and the

Palmata group on the other. The lateral flattening of the lower brachials is scarcely more distinct than in *Antedon* (*Dichrometra*) *flagellata* or *Antedon brevicuneata* (= *Lamprometra palmata*); but P_1 has prismatic lower segments and the ambulacra of the disk, arms, and pinnules are well plated, though the interpalmar areas of the disk are comparatively bare. The genital pinnules are not specially distinguished, however, except by their shortness, and their glands are not protected by any special pavement of plates as in *Antedon* (*Perissometra*) *flexilis* and *A.* (*P.*) *patula*, though there is an ambulacral skeleton above them which is less completely differentiated than in the slender later pinnules. Dr. Carpenter said that the presence of blunt spines on the later cirrus segments also distinguishes this species from *A.* (*P.*) *flexilis*, *A.* (*P.*) *patula*, and *A.* (*P.*) *robusta*, all of which have very smooth cirri, and are altogether of a more robust nature.

In my first revision of the old genus *Antedon* published in 1907 *compressa* was assigned to the genus *Charitometra*. Early in 1908, in a paper on new genera and species of unstalked crinoids, I remarked that *compressa*, which I had placed in *Charitometra*, should have been referred to the genus *Thalassometra*. Later in the same year in describing *Thalassometra fisheri* I compared it with *Thalassometra compressa* "of the Philippines." The Philippine specimens at hand represent *P. granulata* which at that time I had not distinguished from *compressa*. Early in 1909 *compressa* was referred to the new genus *Parametra*.

Dr. Clemens Hartlaub early in 1912 discussed the *Spinifera* group of *Antedon* in considerable detail, including in it 18 species, among them *Antedon compressa*. In my memoir on the crinoids of the Indian Ocean published later in the same year I listed *Parametra compressa*, giving the synonymy and range. The locality "Philippines" refers to *P. granulata*.

In 1913 in a paper on the crinoids in the British Museum, which I had examined in 1910, I recorded and gave notes on two specimens of *Parametra compressa* from *Challenger* station 192 and, under the name of *Parametra granulata*, recorded and gave notes on one specimen from station 201. In my report upon the unstalked crinoids of the *Siboga* Expedition published in 1918 I recorded and described in detail a specimen of *Parametra compressa* from station 302.

Dr. Torsten Gislén in 1928 published additional notes upon the two specimens in the British Museum from *Challenger* station 192.

PARAMETRA GRANULATA A. H. Clark

Plate 7, Figure 25; Plate 10, Figures 31, 32

[See also vol. 1, pt. 2, figs. 874–878, p. 435.]

Antedon compressa (part) P. H. Carpenter, *Challenger* Reports, Zool., vol. 26, pt. 60, 1888, p. 222 (specimen from *Challenger* station 201).

Thalassometra compressa A. H. Clark, Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, p. 227 (*Albatross* station 5110).

Parametra compressa A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 406 (*Albatross* stations 5255, 5166); vol. 39, 1911, p. 554 (*Albatross* stations 5279, 5325, 5367, 5411, 5519, 5523, 5536; specific characters); Crinoids of the Indian Ocean, 1912, p. 213 (in part; records from the Philippine Islands).

Parametra granulata A. H. Clark, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 45 (published reference to specimen in the B. M.; *Challenger* station 201; characters of the division series and lower brachials).—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Pap. 90–D, 1914, pp.

34 and following (inorganic constituents on the skeleton); Prof. Pap. 102, 1917, pp. 102 and following (same).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 158 (in key; range), p. 160 (references; station 105), p. 273 (listed).—F. W. Clarke and W. C. Wheeler, U. S. Geol. Surv. Prof. Pap. 124, 1922, p. 17 (*Albatross* station 5536; inorganic constituents of the skeleton).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8, No. 32 (notes).

Diagnostic features.—The arms beyond the proximal more or less oblong brachials are distinctly carinate; the cirri are short, about one-fifth of the arm length, with the transition segment the eighth, and the distal segments broader than long with prominent dorsal processes or blunt dorsal spines; and the lateral portions of the division series and first two brachials are more or less completely covered with fine tubercles. The 12–20 (usually 17–20) arms are 145–170 mm. long, and the cirri have about 20 segments.

Description.—The cirrus sockets are arranged approximately in 10 columns on the centrodorsal. The cirri are XI, 18; the cirrus segments have a distinct longitudinal carination.

The sides of the division series and lower brachials are more or less covered with fine tubercles, and there is a narrow and low, though prominent, median keel which is continued along the arm and passes into the distal carination. Weak synarthrial tubercles are developed. The division series and lower brachials are considerably smoother than those of *P. compressa*, as the result of the absence of the eversion of the proximal and distal edges.

The 12–20 (usually from 17–20) arms are, in fully developed specimens, 145–170 mm. long.

Note.—The preceding description is based mainly upon the specimen in the British Museum from *Challenger* station 201. The description of the cirri and the mention of the synarthrial tubercles are taken from notes by Prof. Torsten Gislén, and the descriptions of the division series and lower brachials are from my personal notes.

Speaking of the specimen from *Challenger* station 201 Dr. P. H. Carpenter said that it differed from the two other specimens from station 192 on which he based his *Antedon* (*Parametra*) *compressa* in having "much smoother joints at the bases of the arms, their distal edges being but little raised; while in some fragments of a larger form obtained at the same locality there is a tendency to expansion in the third and fourth joints of some of the genital pinnules, which recalls their condition in *Antedon* (*Perissometra*) *flexilis*. The interpalmar areas of the disk are also more plated than in the example from Station 192."

The specimen from *Siboga* station 105 is small with 10 arms about 35 mm. long; the cirri have 15 segments of which the fourth is a transition segment.

Dr. Gislén says that this form seems to be a variety of *P. compressa*, a statement with which I agree.

Localities.—*Albatross* station 5166; Tawi Tawi group, Sulu (Joló) Archipelago; Observation Island bearing N. 20° W., 4.6 miles distant (lat. 4°56′10″ N., long. 119°46′00″ E.); 177 meters; coral sand; February 24, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 35607).

Albatross station 5576; north of Tawi Tawi; Mount Dromedario bearing S. 22° W., 17.2 miles distant (lat. 5°25′56″ N., long. 120°03′39″ E.); 506 meters; bottom temperature 11.8° C.; sand; September 22, 1909 (1, U.S.N.M., 35955).

Siboga station 105; Sulu (Joló) Sea (lat. 6°08′ N., long. 121°19′ E.); 275 meters; coral bottom; July 4, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Challenger station 201; off Mindanao (lat. 7°03′ N., long. 121°48′ E.); 150 meters; stones and gravel; October 26, 1874 [P. H. Carpenter, 1888; A. H. Clark, 1913; Gislén, 1928] (1, B. M.).

Albatross station 5255; Gulf of Dávao; Dumalag Island (S.) bearing S. 65° W., 4.5 miles distant (lat. 7°03′00″ N., long. 125°39′00″ E.); 183 meters; soft mud; May 18, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 35606).

Albatross station 5519; in the vicinity of northern Mindanao; Point Tagolo light bearing S. 71° W., 8.7 miles distant (lat. 8°47′ N., long. 123°31′15″ E.); 333 meters; bottom temperature 12.4° C.; globigerinae and sand; August 9, 1909 [A. H. Clark, 1909] (2 U.S.M.N., 35603).

Albatross station 5523; in the vicinity of northern Mindanao; Point Tagolo light bearing S. 48° W., 6.7 miles distant (lat. 8°48′44″ N., long. 123°27′35″ E.); no depth given; August 10, 1909 [A. H. Clark, 1909] (1, U.S.N.M., 35609).

Albatross station 5536; between Negros and Siquijor; Apo Island (C.) bearing S. 26° W., 11.8 miles distant (lat. 9°15′45″ N., long. 123°22′00″ E.); 510 meters; bottom temperature 11.9° C.; green mud; August 19, 1909 [A. H. Clark, 1909; F. W. Clarke and Wheeler, 1922] (7, U.S.N.M., 35604).

Albatross station 5411; between Cebu and Bohol; Lauis Point light bearing N. 35° E., 4.7 miles distant (lat. 10°10′30″ N., long. 123°51′15″ E.); 265 meters; bottom temperature 12.9° C.; green mud; March 23, 1909 [A. H. Clark, 1909]; (1, U.S.N.M., 35605).

Albatross station 5367; Verde Island Passage; Malabrigo light bearing N. 81° E., 8 miles distant (lat. 13°34′37″ N., long. 121°07′30″ E.); 329 meters; sand; February 22, 1909 [A. H. Clark, 1909] (5, U.S.N.M., 35601).

Albatross station 5279; China Sea in the vicinity of southern Luzon; Malavatuan Island (W.) bearing S. 18° W., 5.4 miles distant (lat. 13°57′30″ N., long. 120°22′15″ E.); 214 meters; green mud; July 17, 1908 [A. H. Clark, 1909] (2, U.S.N.M., 35602, 35954).

Albatross station 5110; China Sea off southern Luzon; Corregidor light bearing N. 20° E., 25 miles distant (lat. 13°59′20″ N., long. 120°75′45″ E.); 247 meters; bottom temperature 15° C.; dark gray mud; January 15, 1908 [A. H. Clark, 1908] (2, U.S.N.M., 35608).

Albatross station 5325; off northern Luzon; Hermanos Island (N.) bearing N. 86° E., 16.75 miles distant (lat. 18°34′15″ N., long. 121°51′15″ E.) 409 meters; bottom temperature 11.8° C.; green mud; November 12, 1908 [A. H. Clark 1909].

Geographical range.—Philippine Islands, from the Tawi Tawi group northward to northern Luzon.

Bathymetrical range.—From 150 to 510 meters; the average of 12 records is 300 meters.

Thermal range.—From 11.8° to 15.0° C.; the average of 6 records is 12.6° C.

History.—The first known specimen of this species was a young individual dredged by the *Challenger* at station 201 and recorded by Dr. P. H. Carpenter under the name of *Antedon compressa* in the *Challenger* report on the comatulids in 1888. Carpenter briefly noted certain differences between this specimen and the two types of *compressa* from station 192, and mentioned some features of fragments of a larger individual taken with it.

In 1908 I recorded this species as *Thalassometra compressa* from *Albatross* station 5110. Under the name *Parametra compressa* I recorded two specimens from *Albatross* stations 5166 and 5255 in 1909, and 18 specimens from stations 5279, 5325, 5367, 5411, 5519, 5523, and 5536 in 1911, giving brief notes on the latter.

In my memoir on the crinoids of the Indian Ocean published in 1912 these Philippine records were included under *Parametra compressa*.

In 1913 under the name *Parametra granulata* I published a note on the specimen from *Challenger* station 201 which I had examined at the British Museum in 1910, citing certain differences between it and the two specimens of *P. compressa* from station 192, with which I compared it directly.

In 1914 Prof. Frank Wigglesworth Clarke and Dr. W. C. Wheeler published a chemical analysis of the skeleton of *Parametra granulata* based upon material from the Philippines which I had given them. Their analysis was republished in 1922.

In my report upon the unstalked crinoids of the *Siboga* expedition published in 1918 I inserted *granulata* in a key to the species of *Parametra* and recorded and gave notes on a young specimen from station 105.

In 1928 Prof. Torsten Gislén gave additional notes on the *Challenger* specimen from station 201 which he had examined in London.

PARAMETRA ORION (A. H. Clark)

Plate 5, Figures 19, 20; Plate 8, Figure 27; Plate 10, Figure 30

[See also vol. 1, pt. 1, figs. 4, p. 63, 18, p. 67, 201, 202, p. 239, 270, p. 259, 489, p. 365; pt. 2, figs. 217, p. 163, 251, p. 199, 745, p. 349.]

Antedon orion A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 143 (description; *Albatross* station 4934); vol. 34, 1908, p. 486.

Charitometra orion A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 125 (should have been referred to *Thalassometra*).

Thalassometra orion A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 125 (at first wrongly referred to *Charitometra*); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 225 (comparison with *Th.* [*Parametra*] *fisheri;* systematic position), p. 226 (comparison with *Th.* [*Cosmiometra*] *delicata*), p. 310 (Sagami Bay).

Parametra orion A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 16 (listed); Vid. Medd. Naturhist. Foren. København, 1909, p. 187 (Eastern Sea near Nagasaki, 170 fathoms; description of the specimen); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 554 (between Pracas [Pratas] reef and Formosa; compared with *P. compressa*); Crinoids of the Indian Ocean, 1912, p. 213 (synonymy; range); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 182 (south of the Goto Islands, 124 fathoms); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 158 (in key; range), p. 160 (references).—Mortensen, Studies in the development of crinoids, 1920, p. 4 (size of eggs).

Perissometra aranea Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 5 (200 meters), p. 6 (Kiu Shiu and Goto Islands), p. 120 (station 7a; detailed notes), p. 180 (listed), figs. 103, 104, p. 122; Zool. Bidrag Uppsala, vol. 9, 1924, p. 285 (Kiu Shiu; 198 meters; details); Vid. Medd. Dansk Naturh. Foren. København, vol. 83, 1927, p. 2 (station 7; 198 meters), p. 33 (station 7; notes), p. 34 (compared with *P. carinata*), p. 68 (listed), fig. 23, p. 27; Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8; Vid. Medd. Dansk Naturh. Foren. København, vol. 93, 1933, p. 481.

Monachometra cf. *fragilis* Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 44, 51; fig. 14, p. 48 (base of a postradial series).

Perissometra cf. *aranea* Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 80 (note on syzygial faces).

Perissometra carinata Gislén, Vid. Medd. Dansk Naturh. Foren. København, vol. 83, 1927, p. 2 (station 9; 162 meters), p. 34 (station 9; description; comparisons), p. 68 (listed), figs. 24, 25, p. 37, pl. 2, fig. 84; Vid. Medd. Dansk Naturh. Foren. København, vol. 93, 1933, p. 481.

Monachometra mortenseni Gislén, Vid. Medd. Dansk Naturh. Foren. København, vol. 83, 1927, p. 2 (station 9; 162 meters), p. 35 (station 9; description; comparisons), p. 68 (listed), figs. 26, 27, p. 37, pl. 1, fig. 83; Vid. Medd. Dansk Naturh. Foren. København, vol. 93, 1933, p. 481.

Monachometra fragilis Gislén, Vid. Medd. Dansk Naturh. Foren. København, vol. 83, 1927, p. 38 (comparisons); Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 21.

Diagnostic features.—The arms beyond the proximal more or less oblong brachials are distinctly carinate; the cirri are short, about one-fifth of the arm length, with usually 20–25 segments of which the eighth is a transition segment and the distal are broader than long with strong carinate processes or blunt dorsal spines; and the lateral portions of the division series and first two brachials may be unmodified or more or less extensively irregularly tubercular, with or without a fine median raised line. The 10–18 arms are 125–140 mm. long, and the cirri are 20–25 mm. long.

Description of the type specimen.—The centrodorsal is a thick disk with the flat and somewhat roughened dorsal pole broad, 4 mm. in diameter and the sides practically vertical. The cirrus sockets are arranged in 15 closely crowded columns of one or two each.

The cirri are XXI, 15–25, from 20 to 25 mm. long, almost or quite straight in the proximal third and strongly and regularly recurved in the distal two-thirds so that the extreme tip is parallel with the basal portion. In a fully developed cirrus the first segment is very short, in some cases only the dorsal half projecting beyond the cirrus socket; the second is about three times as broad as long, the proximal border with a strong broadly rounded median angle and the distal border concave; the third is about twice as long as the greatest (midlateral) length with the proximal and distal borders as in the preceding though with the curvature somewhat less pronounced; the fourth is half again as broad as long; the fifth is about as long as, or slightly longer than, broad; the sixth is slightly longer; the seventh is about one-third again as long as broad; and the eighth, a transition segment, is twice as long as the median width. The transition segment, usually the eighth though often the seventh, is basally slightly less in width than the distal end of the segment preceding; it tapers markedly in the proximal two-thirds, in the distal third increasing slightly in width; the proximal two-thirds has a dull surface like that of the segments preceding but is darker in color; the distal third is very light with a polished surface like the following segments. The cirri are stout at the base but taper rather abruptly on the transition segment so that the portion beyond that segment is in lateral view only about three-quarters the width of the basal portion. The segments immediately following the transition segment are more or less longer than broad, but after one or two they become slightly broader than long. These segments have a median dorsal carination which at first is rounded but soon becomes sharp. In lateral view the profile of the dorsal surface of these segments rises in a curved convexity from the proximal to the distal end so that the distal end projects beyond the base of the segment next following and may sometimes be produced into a short sharp point. The opposing spine is represented by a low subterminal elevation involving the entire dorsal surface of the penultimate segment; this is usually more or less broadly rounded, rarely pointed. The terminal claw is usually about as long as the penultimate segment and is stout, rapidly tapering, moderately curved, and usually with a blunt tip.

The ends of the basal rays are visible as small more or less irregular tubercles in the interradial angles beneath the inverted V formed by the narrow lateral ends of adjacent radials.

The radials are concealed by the centrodorsal except for the narrow lateral ends that meet above the ends of the basal rays. Narrow and shallow slitlike subradial clefts are present. The IBr_1 are short and bandlike with the proximal and distal borders slightly curved and parallel and the lateral ends in apposition with those of their neighbors on either side. The IBr_2 (axillaries) are short, about three times as broad as long, rhombic with pointed or slightly truncated angles, and in lateral apposition. The IIBr series, which are 2, resemble the IBr series but are somewhat longer. The proximal and distal borders of the ossicles of the division series may be slightly and broadly thickened, but there is no trace of a median carination or other modification of the surface. The dorsal surface is moderately convex.

The 13 arms are about 125 mm. long. The first brachials are short, about four times as broad as long, slightly longer exteriorly than interiorly, with the proximal and distal borders straight and almost parallel. They are interiorly united for their whole length and externally are in contact with their neighbors against which they are rather narrowly flattened. The second brachials are larger than the first, irregularly quadrate or triangular with the inner side reduced to a point and the proximal border rather strongly curved. The first syzygial pair (composed of brachials 3+4) is oblong, usually about twice as broad as long, with the hypozygal and epizygal of the same size. The next five or six brachials are oblong, about three times as broad as long, those succeeding becoming wedge-shaped and soon almost as long as broad, remaining of the same proportions until the terminal portion of the arm, where they become somewhat elongated. The oblong brachials at the base of the arm are slightly constricted centrally and there is a slight suggestion of indistinct broad and low articular tubercles, so that this portion of the arm appears somewhat irregular and rugose. There is no trace of carination or other ornamentation of the dorsal surface. On about the twelfth brachial the middorsal portion becomes elevated in a V-shaped area with a rounded summit, the apex of the V being in the middle of the proximal border and the narrow side, which is finely serrate, on the distal border. At first these V-shaped elevations alternate on either side of the median line, but they soon become aligned along the middorsal line of the arm. The arm now becomes compressed laterally, after about the proximal third becoming narrow and high with a conspicuous narrowly rounded median carination which is higher on the distal than on the proximal ends of the brachials so that the arm appears serrate in lateral view.

Syzygies occur between brachials 3+4 and 13+14 or 14+15, and distally at intervals of from 6 to 12 muscular articulations.

P_1 is 6.5 mm. long with 15 segments, only slightly larger than the pinnules following, tapering evenly and regularly from the base to the tip. The first segment is somewhat broader than long, those following slowly increasing in length, becoming as long as broad on the sixth or seventh and somewhat longer than broad distally. The pinnule is somewhat flattened exteriorly; the segments have finely serrate distal edges and the distal outer angle may be somewhat produced. P_2 resembles P_1 but is slightly shorter and less stout. The pinnules following decrease gradually in length to about P_6, which is 4 mm. long with 9 segments, all broader than long except the last two. The genital pinnules increase slowly in width from the base to the third segment, thence tapering to the tip, the second and third, or second-fourth segments being slightly broadened. The distal pinnules are more slender, 7 or 8 mm. long with 18 segments, all of which are about as long as broad and very sharply carinate.

The disk is moderately or well plated, and the ambulacra are well plated. Sacculi are abundant on the pinnules.

Notes.—In other specimens from the type locality the proximal, distal, and lateral borders of the elements of the IBr series and the lateral borders of the IIBr series may be more or less extensively irregularly tuberculate, this tuberculation sometimes involving the entire dorsal surface of the IBr$_1$, and some specimens show a very distinct, though low and narrow, middorsal line on the division series and on all the brachials of the proximal portion of the arms.

Gislén's original description of *Perissometra aranea* based upon a single specimen from Bock's station 7a is as follows: The centrodorsal is a low cone 2 mm. in diameter, dorsally with a central cavity and small side cavities. The cirrus sockets are arranged in 10 columns, one or two in each column.

The cirri are XIV, 17–21, 10–11 mm. long. The first-third segments are broader than long, the fourth is somewhat longer, the fifth is half again as long as broad, and the sixth is twice as long as broad, distally a little widened and with an inconspicuous dorsal spine. The segments following are shorter, each with a dorsal spine. From about the ninth the segments are about as long as broad; the antepenultimate is half again as long as broad. The opposing spine reaches a height of about one-fifth of the penultimate segment. The terminal claw is curved and is somewhat longer than the segment preceding.

The radials are in the form of narrow bands, almost concealed. The IBr$_1$ are four times as broad as long with a low median carination and are in lateral contact. The IBr$_2$ (axillaries) are pentagonal, three times as broad as long, with a similar low longitudinal tubercle. There is a slight thickening of the distal border, the rest of the ossicle being smooth. It is laterally flattened like the IBr$_1$.

The 10 arms are 70 mm. long. The first two brachials have a carination similar to that on the IBr series but very much slighter. The first brachials are internally contiguous in pairs, externally broader (longer), as are also the second brachials. The proximal brachials are rounded and smooth. The first 10 brachials are discoidal, those following irregularly oblique. From the fifteenth onward there is a low median longitudinal crest slightly projecting in lateral profile.

Syzygies occur between brachials 3+4, 13+14, 18+19, and distally at intervals of about 5 oblique muscular articulations.

P_1 is 5 mm. long with 13 segments. P_a is also 5 mm. long with 13 segments. P_2 is 3.5 mm. long with 8 or 9 segments. P_3 is similar. P_1 is coarser than P_2. The segments of these pinnules are rather uniform, smooth, a little longer than broad, distally somewhat angular. P_4 to P_{12} are 3–4 mm. long with about 10 segments of which the proximal are very slightly flattened dorsoventrally. The distal pinnules are 5–6 mm.

long with about 14 segments of which the first and second are shorter and a little coarser than those following, which are twice as long as broad.

The disk is a little incised with large calcareous granules, 4 mm. in diameter.

The color is light yellow-brown, the disk brown.

Gislén said that after comparison with specimens from Dr. Mortensen's collection he is convinced that this species often has 11 or 12 arms up to 70 mm. long. The IIBr series are 2. P_1 may have 15 segments and reach a length of about 6 mm. P_2 to P_{10} are short with the five or six proximal segments somewhat thickened in dorsal view.

He remarked that in the short genital pinnules the species has an unusual resemblance to a spider, hence the name.

In 1927 Professor Gislén published notes on the specimens from Mortensen's station 7 to which he referred in the original description. Of the first specimen he said that the centrodorsal is almost hemispherical, 3.0 mm. in basal diameter and 2.0 mm. across the slightly convex dorsal pole. The cirrus sockets are arranged in 10 columns, 1 or 2 to a column.

The cirri are XIII, 19–22, from 13 to 15 mm. long. The sixth or seventh is a transition segment, three-quarters again as long as the distal width, with the first dorsal spine protruding from the distal part.

The IBr_1 are five times as broad as long with a well delimited median carination which continues on to the proximal part of the IBr_2 (axillary). The IIBr series are 2. The ossicles of the IBr and IIBr series have a slightly everted proximal border and two or three small pits on each side of the low median carination.

The 11 arms are 70+ mm. long. The low median carination on the division series is continued out to the distal parts of the arms. The distal brachials have slightly everted distal borders and a rather strong median carination.

The distal intersyzygial interval is from 4 to 9 (usually 5 or 6) muscular articulations.

P_1 is 6.5 mm. long with 13–14 segments. P_2 is 4 mm. long with 8–10 segments. P_3 is 3 mm. long with 7–9 segments. P_4 is 3 mm. long with 7 segments. P_7 is 4 mm. long. The distal pinnules are 8 mm. long with 18 segments. The disk is 5 mm. in diameter.

In a second specimen from the same station the cirri are XVII, 22–23, 13–16 mm. long, in 11 columns. The 12 arms are 70+ mm. long. The dorsal carination is as in the preceding specimen. P_1 is 5 mm. long with 14–16 segments. P_2 is 4.5 mm. long with 11 segments. P_4 is 3.7 mm. long with 10 segments. The disk is 5 mm. in diameter and bears coarse granules. The anal cone is 1.5 mm. high.

A third specimen from the same station has the cirri XVI, 18–23, from 10 to 12 mm. long, arranged in 10 columns. The arms, which are partly broken, were at least 11, and are 60 mm. long. P_1 is 4.5 mm. long with 12 segments. P_3 is 2.5 mm. long with 7 segments. The distal pinnules are 6 mm. long with 12 segments of which the longest are from two to two and one-half times as long as broad.

In his original description Gislén said that this supposed new species most closely resembles *Glyptometra lata* from which, however, it differs sharply by the cirri, very short in comparison with the arm length, but in spite of this with relatively many segments; by the rather smooth proximal arm parts; and, above all, by the proximal pinnules which have few and rather long segments.

Later he said that by the low median dorsal carination of the arms this species approaches *Chondrometra rugosa* and *Glyptometra tuberosa*. From the species first mentioned it is, however, easily distinguished by much smaller size, by a low centrodorsal carrying only XIII–XX cirri, and by more cirrus segments, though the cirri are only half as long as those of *Chondrometra rugosa*. It differs from *Glyptometra tuberosa* in having more cirrus segments which are provided, besides, with small but distinct dorsal spines, by smoother arm bases, by P_1 having much fewer segments, and by the smaller size.

The description of the cirri and of the relation between P_1 and P_2 show that these specimens belong to a species in the family Thalassometridae, not in the family Charitometridae, and they are quite indistinguishable from specimens of *Parametra orion* of corresponding size.

Gislén described *Perissometra carinata* as follows: The centrodorsal is conical, 3 mm. broad at the base and 3 mm. high, with distinct interradial crests. The cirrus sockets are arranged in 10 columns.

The cirri are XXI, 20–21, about 15 mm. long. The fourth segment is slightly longer than broad; the sixth segment is half again as long as the distal width and is a transition segment; from the distal part of this segment the segments are polished and are provided with a dorsal spine. This dorsal spine is peculiar in appearance, as from the eighth segment it transforms into a strong longitudinal carination, a notch occurring between the carination of two successive cirrus segments. The segments from the eighth to the penultimate are one-third again as broad as long. The opposing spine is small but distinct. The curved terminal claw is about equal to the preceding segment in length.

The radials are concealed. The IBr_1 are four times as broad as long, free laterally though close to their neighbors, with sharp distolateral angles. There is a well defined median crest and on each side of the median line a couple of indistinct pits. The IBr_2 (axillaries) are three times as broad as long, pentagonal, with a raised and slightly spiny proximal border; there is a sharp median carination in the proximal two-thirds. The IIBr series are 2, and have a median carination similar to that on the IBr series.

There are at least 12 arms (one postradial series is broken) 65 mm. long. The proximal portion of the postradial series is not flattened laterally. The carination continues dorsally out to the distal portion of the arms, which is slightly compressed laterally. The brachials as far as the tenth are discoidal. The width of the proximal portion of the arms is 1.7 mm. The distal brachials are slightly thickened at their distal ends.

In three cases out of ten the first syzygy (between brachials 3+4) is replaced by a synarthry. The distal intersyzygial interval is 7 or 8 oblique muscular articulations.

P_1 is 6 mm. long with 14–15 segments which are squarish and slightly prismatic. P_2 is 4.4 mm. long with 11–12 segments. P_5 is 3.2 mm. long with 7 segments. The distal pinnules are 6.2 mm. long with about 16 segments.

The disk has been lost.

In another specimen the centrodorsal is 1.8 mm. broad at the base and 1.2 mm. high. The cirri are partly broken. The dorsal carination is weaker than in the specimen just described, more protruding in the distal part of the segment. The radials are six times as broad as long. The IBr_1 are three times as broad as long, with a weak carination. The IBr_2 (axillaries) are two-fifths as long as broad with a carination in the proximal part, but otherwise smooth. The 11+ partly broken arms are about 30 mm. long.

Professor Gislén said that this species is very similar to *P. aranea*, differing in the more distinctly conical centrodorsal and above all by the carination of the distal cirrus segments.

The two chief diagnostic features given in the description are, first, the occurrence of a transition segment in the cirri beyond which is a series of highly polished spine-bearing segments; and, second, the shortness of P_2 as compared with P_1. These features indicate that these specimens belong to a species of Thalassometridae, not to a species of Charitometridae. Taken in connection with other characters given, especially the compression and carination of the outer portion of the arms, they place the specimens in the genus *Parametra*, in which genus they show no features by which they may be distinguished from *P. orion*, of which they are undoubtedly only small individuals.

Professor Gislén gave no formal description of *Monachometra mortenseni*, contenting himself with notes on 12 specimens from Mortensen's station 9, the station from which came the type specimen of his *Perissometra carinata*. (1) The centrodorsal is a thick disk 3 mm. in diameter with the free dorsal pole flattened and 2.5 mm. in diameter. The cirri are arranged in an almost simple row and in 15 columns. The cirri are XVI, 17–19, 12 or 13 mm. long. The third segment is about as long as broad and the sixth or seventh are the longest, half again as long as the distal breadth; the outer part of this segment is polished and like the following segments is provided with a weak dorsal prominence in the distal part. The opposing spine is small but distinct and unforked. The radials are concealed. The IBr_1 are six times as broad as long. The IBr_2 (axillaries) are two-fifths as long as broad and like the IBr_1 have a weak median longitudinal carination; the proximal and distal borders are slightly raised. The 11 arms are 55 mm. long. The IIBr series are 2. The proximal parts of the arms, though closely set, are not wall-sided. There is a very weak and indistinct carination out to the distal parts of the arms. Syzygies occur between brachials 3+4 and 13+14 and distally at intervals of from 6 to 10 muscular articulations. P_1 is 5 mm. long with 11–13 segments. P_2 is 2.8 mm. long with 8 segments. P_5 is 2.3 mm. long with 7 segments. The distal pinnules are 5.2 mm. long with 14–15 segments. The disk is 4.3 mm. in diameter and is coarsely granular. The anal cone is short, 1.3 mm. high. The color is banded yellow-brown, the dorsal pole of the centrodorsal darker.

(2) The diameter of the centrodorsal is 3 mm. The cirri are XV, 18–20, from 10–13 mm. long. The arms are 13+, 55 mm. long. They are partly broken and probably were 16 when the specimen was complete; four rays have 3, 3, 3, and 4 arms. The median carination is indistinct. P_1 is 5 mm. long with 13 segments. P_2 is 3.7 mm. long with 9 segments. P_3 is 2.8 mm. long with 7 segments. P_5 is 2.5 mm. long with 7 segments. The distal pinnules are 4.5 mm. long with 11 segments.

(3) The diameter of the centrodorsal is 2.8 mm. The cirri are only XIII, 18, about 11 mm. long. The arms are 11, 75 mm. long; the IBr_1 is eight times as broad as long. The proximal portions of the arms are 1.2 mm. in breadth. P_1 is 6.2 mm. long with 16 segments. P_3 is 3.2 mm. long with 8 segments.

(4) The diameter of the centrodorsal is 3.5 mm. The cirri are XV, 21–23, from 13 to 18 mm. long in 14 columns. The 12 arms (perhaps 13 when the specimen was

complete) are broken. The breadth of the proximal portion of the arms is 1.7 mm. The intersyzygial interval is from 4 to 11 muscular articulations. P_1 is 8.2 mm. long with 15 segments. P_2 is 5.8 mm. long with 14 segments. P_3 is 4.8 mm. long with 11 segments. P_7 is 3.8 mm. long with 9 segments.

(5) The 13 arms have full-grown regenerates of brighter color than the proximal portions. This specimen was attached to a sponge.

(6) The cirri are in 14 columns. They are XV, about 20, about 12 mm. long. The 12 arms are 60 mm. long. P_1 is about 5 mm. long with 14 segments. P_3 is 2.4 mm. long with 8 segments. The distal pinnules are 4.5 mm. long with 12 segments. The disk has coarse granules along the ambulacral furrows.

(7) The diameter of the centrodorsal is 3.2 mm. The cirri are XV, 21, about 13 mm. long. The 18 arms are all broken. The disk is 6.5 mm. in diameter and is plated with coarse granules.

(8) The cirri are in 15 columns and are XV, 21–22. The 13 +arms (on three postradial series 3, 3, 3) are 65 mm. long. P_1 is 6 mm. long with 16 segments. P_2 is 3.3 mm. long with 9 segments. P_4 is 2.8 mm. long with 6 segments.

(9) The cirri are XV, about 20. The 15 arms are 55 mm. long. P_1 is 6 mm. long with 16 segments. P_2 is 3 mm. long with 9 segments. The distal pinnules are 5 mm. long with 11 segments.

(10) The diameter of the centrodorsal is 2.8 mm. The cirri are XIV, 20–23. The arms are at least 13, 60 mm. long. The diameter of the disk is 4.8 mm. This is a 6-rayed specimen.

(11 and 12) These specimens are dried; they have 11 and 12 arms.

Gislén said it seemed to him that with the present limitation of the genera within the Charitometridae one must refer this species (*mortenseni*) to *Monachometra*. The only species previously referred to this genus, *M. fragilis*, differs sharply from *M. mortenseni*. He noted I had informed him that the opposing spine is double in *M. fragilis*, as in *Diodontometra*. From this genus it is distinguished by the totally different appearance of the centrodorsal. *Monachometra mortenseni* has a simple opposing spine, and besides dorsal spines, which are absent in *M. fragilis*, other differences are: In *M. mortenseni* the cirri are XV, about 20, about 13 mm. long, whereas in *M. fragilis* the cirri are XXX, 17–18, from 30 to 35 mm. long. In *M. mortenseni* the arms are about 15, from 55 to 75 mm. long, not wall-sided, whereas in *M. fragilis* they are 19, 145 mm. long, and strongly wall-sided. In *M. mortenseni* P_1 is 5 mm. long with about 14 segments; P_2 is about 3 mm. long with about 10 segments; P_3 is about 3 mm. long with about 8 segments, whereas in *M. fragilis* P_1 is 9 mm. long with about 30 segments; P_2 is about 10 mm. long with 25 segments; and P_3 is 11 mm. long with 22 segments. The largest and stoutest specimen of *M. mortenseni* (specimen 4) only slightly surpasses these figures. In the Uppsala Museum there is a specimen of *M. fragilis* which has permitted direct comparison; it has 20 arms 130 mm. long.

Gislén added that the two species of the genus *Monachometra* are surely not closely related. Nevertheless they must be provisionally ranged in the same genus which will, perhaps, not be possible in the future, as the classification of the Charitometridae is still not completely satisfactory.

The figures of the cirrus and of the earlier brachials with P_1 and P_2 given by Professor Gislén are typical of *Parametra orion*, and there is nothing in the descriptions of the specimens to indicate that his specimens do not belong to this species.

The specimen from near Nagasaki in 311 meters has 14 arms 130 mm. long, and XV cirri 20 mm. long arranged in a single marginal row.

The specimen from south of the Goto Islands in 223 meters has 15 arms 125 mm. long and the cirri XVIII, 23–24, from 21 to 23 mm. long.

It was from one of these two specimens that Dr. Mortensen secured the eggs, which he found to be 0.15 mm. in diameter.

In this species the arms vary from 10 to 18 in number and reach a length of 140 mm. In fully developed individuals the cirrus sockets are arranged in 15 columns on the centrodorsal, but in small ones there are commonly only 10 columns.

Localities.—*Albatross* station 5306; China Sea, near Pratas reef (lat. 20°55′00″ N., long. 116°40′00″ E.); 306 meters; bottom temperature 10.78° C.; coral and sand; October 26, 1908 [A. H. Clark, 1911, as "Between Praeas Reef and Formosa," 1912, 1915, 1918] (3, U.S.N.M., 35618).

Dr. Sixten Bock's Expedition to Japan 1914; station 7a; 23 miles northwest of the Goto Islands (lat. 32°17′ N., long. 128°11′ E.); 201 meters; May 14, 1914 [Gislén, 1922].

Dr. Th. Mortensen's Pacific Expedition 1914–16; station 7; 23 miles northwest of the Goto Islands (lat. 32°17′ N., long. 128°11′ E.); 201 meters; sand; May 14, 1914. This is the same station as Bock's station 7a; Drs. Bock and Mortensen were working together at this time [Gislén, 1922, 1924, 1927].

Dr. Th. Mortensen's Pacific Expedition 1914–16; station 9; near the Goto Islands (lat. 32°15′ N., long. 128°12′ E.); 162 meters; hard bottom; May 15, 1914 [Gislén, 1927].

Albatross station 4904; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki Light bearing N. 27° E., 6 miles distant (lat. 32°31′20″ N., long. 128°32′40″ E.); 192 meters; fine gray sand and broken shells; August 10, 1906 [A. H. Clark, 1912, 1915, 1918] (1, U.S.N.M., 35622).

Albatross station 4903; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki Light bearing N. 22° E., 6 miles distant (lat. 32°31′10″ N., long. 128°33′20″ E.); 192–250 meters· bottom temperature 11.61° C.; gray sand and broken shells; August 10, 1906 [A. H. Clark, 1912, 1915, 1918] (2, U.S.N.M., 35567).

Albatross station 4901; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki Light bearing N. 9° E., 6.5 miles distant (lat. 32°30′10″ N., long. 128°34′40″ E.); 250 meters; bottom temperature 11.61° C.; gray sand and broken shells; August 10, 1906 [A. H. Clark, 1912, 1915, 1918] (1, U.S.N.M., 35621).

Albatross station 4902; Eastern Sea, between 10 and 20 miles southwest of the Goto Islands; Ose Saki Light bearing N. 10° E., 6 miles distant (lat. 32°30′50″ N., long. 128°34′40″ E.); 250 meters; bottom temperature 11.61° C.; gray sand and broken shells; August 10, 1906 [A. H. Clark, 1912, 1915, 1918] (1, U.S.N.M., 35619).

Eastern Sea, near Nagasaki (lat. 30°22′ N., long. 128°42′ E.); 311 meters; Captain Suensson, November 11, 1901 [A. H. Clark, 1909, 1912, 1915, 1918] (1, C. M.).

Eastern Sea, south of the Goto Islands (lat. 32°25′ N., long. 128°52′ E.); 223 meters; bottom temperature 12.78° C.; Captain Suensson [A. H. Clark, 1913, 1915, 1918] (1, C. M.).

Albatross station 4888; Eastern Sea, about 20 miles southwest of Nagasaki Entrance; Nomo Zaki bearing N. 57° E., 16.5 miles distant (lat. 32°26′00″ N., long. 129°27′30″ E.); 128 meters; bottom temperature 15.39° C.; dark gray sand and broken shells; August 8, 1906 [A. H. Clark, 1912, 1915, 1918] (3, U.S.N.M., 35623).

Albatross station 4934; Eastern Sea, off Kagoshima Gulf; Sata Misaki Light bearing N. 77.5° E., 7 miles distant (lat. 30°58′30″ N., long. 130°32′00″ E.); 185–273 meters; bottom temperature 15.89° C.; rocky bottom; August 16, 1936 [A. H. Clark, 1907, 1908, 1912, 1915, 1918] (15, U.S.N.M., 22627, 35564, 35565, 35620, 36185).

Albatross station 4935; Eastern Sea, off Kagoshima Gulf; Sata Misaki Light bearing N. 58° E., 4.5 miles distant (lat. 30° 57′20″N., long. 130°35′10″ E.); 185 meters; bottom temperature 15.89° C.; bottom, stones; August 16, 1936 [A. H. Clark 1912, 1915, 1918] (1, U.S.N.M., 35566).

Albatross station 5070; Suruga Gulf; Ose Saki bearing S. 8° W., 1.8 miles distant (lat. 35°03′25″ N., long. 138°47′40″ E.); 194 meters; bottom temperature 14.22° C.; mud, sand, and broken shells; October 15, 1906 [A. H. Clark, 1912, 1915, 1918] (2, U.S.N.M., 35624; M.C.Z., 344).

Albatross station 5069; Suruga Gulf; Ose Saki bearing S. 6.5° E., 1.7 miles distant (lat. 35°03′10″ N., long. 138°47′00″ E.); 194–236 meters; bottom temperature from 13.22° to 17.22° C.; mud, sand, and broken shells; October 15, 1906 [A. H. Clark, 1912, 1915, 1918] (3, U.S.N.M., 35617).

Sagami Bay (lat. 35°03′ N., long. 138°47′ E.); 153 meters; Alan Owston, yacht *Golden Hind* [A. H. Clark, 1908, 1912, 1915, 1918] (1, U.S.N.M., 35625 [original No. 7010]).

Albatross station 3719; off southern Japan; Ose Zaki bearing S. 13° W., 1.5 miles distant; 128–166 meters; volcanic sand, shells, and rock; May 11, 1900 (1, M.C.Z., 270).

Geographical range.—From the vicinity of Hong Kong northward to southern Japan, from the Korean Straits to Sagami Bay.

Bathymetrical range.—From 128 to 306 meters; the average for all the records is 219 meters.

Thermal range.—From 10.78° to 15.89° C.; the average for all records is 13.67° C.

Character of bottom.—Rocky; stones; mud, sand, and broken shells; coral and sand; dark gray sand and broken shells; fine gray sand and broken shells; gray sand and broken shells.

Note.—This is by far the most common and most generally distributed species of the family Thalassometridae occurring in Japan, just as the corresponding species, *P. granulata*, is the most common and most generally distributed species of the family in the Philippine Islands.

History.—This species was first described under the name of *Antedon orion* in a paper published on September 17, 1907. The type specimen had been dredged by the *Albatross* at station 4934 in the previous year.

In my first revision of the old genus *Antedon* published on October 29, 1907, this species was transferred to the new genus *Charitometra* and was listed as *Charitometra orion*. In a paper on new genera of unstalked crinoids published on April 11, 1908, I remarked that "the species *compressa* and *orion*, placed in *Charitometra*, should have been referred to *Thalassometra* . . ." In another paper published on May 14, 1908, I wrote that "In the lists of species belonging to the two genera published when I established *Thalassometra* and *Charitometra*, *orion* and *compressa* were erroneously assigned to the latter." In a revision of the families Thalassometridae and Himerometridae published on January 9, 1909, I established the new genus *Parametra* with *Antedon orion* as the genotype. In a paper on the crinoids of the Zoological Museum at Copenhagen published later in 1909 I recorded a specimen of *Parametra orion* from near Nagasaki in 170 fathoms and gave notes regarding it. In a preliminary paper on a collection of crinoids made by the United States Fisheries steamer *Albatross* in the Philippine region published in 1911 I recorded three specimens, all bright yellow, from between Pracas (=Pratas) reef and Formosa. The locality was *Albatross* station 5306 although this was not stated as no station number accompanied the specimens. I wrote that "This species has the division series invariably smooth laterally and without any median carination. It possesses rather fewer arms than *P. compressa* [=*P. granulata*] and does not reach so large a size." In my memoir on the crinoids of the Indian Ocean published in 1912 I listed *Parametra orion*, giving the range as southern Japan and southward to Formosa (Taiwan) in 85–170 fathoms. In a paper on some crinoids from eastern Asia collected by Captain Suensson while in command of one of the Danish cable-repair steamers I recorded *Parametra orion* from south of the Goto Islands in 223 meters and gave notes on the specimen. In a paper on the distribution of the comatulids of the coasts of China and Japan published in 1915 the bathymetrical and thermal ranges of *Parametra orion* were given. In my report on the unstalked crinoids of the *Siboga* expedition published in 1918 I inserted *orion* in a key to the species of *Parametra* and gave the geographical and bathymetrical ranges and the synonymy.

Dr. Theodor Mortensen in a memoir on the development of crinoids published in 1920 stated that the eggs of *Parametra orion* are 0.15 mm. in diameter, only a little smaller than the eggs of *Tropiometra carinata*, which are 0.2 mm. in diameter.

In 1922 Prof. Torsten Gislén described *Perissometra aranea* from a single specimen collected by Dr. Sixten Bock at his station 7a near the Goto Islands and figured a distal pinnule and a cirrus, both of which are typical of this species. He also mentioned specimens in Dr. Mortensen's collection. In his memoir on the Japanese crinoids collected by Dr. Theodor Mortensen in 1914 he gave notes on three specimens of *Perissometra aranea* from station 7, which is the same locality as Bock's station 7a, and figured a P_1 from one of them. He also described *Perissometra carinata* from two specimens from station 9, figuring the centrodorsal and cirri and the second-fifth brachials with P_1 and P_2, and giving a photograph of the type specimen twice enlarged. In the same memoir Professor Gislén described *Monachometra mortenseni* from 12 specimens from station 9, and figured a cirrus and the lower part of an arm with P_1 and P_2.

It is, perhaps, only fair to Professor Gislén to say that the description of *Perissometra aranea*, *P. carinata*, and *Monachometra mortenseni*, all based upon immature individuals of *Parametra orion* should not be regarded as any reflection on him. The available description of *P. orion* was poor and deficient in several important respects, and it had not been figured. Superficially *Parametra orion* certainly resembles some species of Charitometridae more closely than it does most of the species of Thalassometridae. Everyone who has worked with the comatulids has made similar slips, and personally I have been guilty of some much more serious ones.

PARAMETRA LISA, sp. nov.

Diagnostic features.—The arms beyond the proximal more or less oblong brachials are distinctly carinate; and the cirri, which are arranged in 10 columns on the centrodorsal and are about one-quarter of the arm length with 25–26 segments, have the transition segment the eighth, and the distal segments as long as broad with very small and obscure dorsal processes. The 19 arms are 115 mm. long, and the cirri are 20–28 mm. long.

Description.—The centrodorsal is low, conical, with a low rounded conical dorsal pole. The cirrus sockets are arranged in 10 columns of usually two each, there being two columns in each radial area. The columns are in close contact interradially, but are slightly separated in the mid-radial lines.

The cirri are XXI, 25–26, from 20 to 28 mm. in length, and rather slender. The first segment is very short, the second is about twice as broad as long, the third is slightly broader than long, the fourth is about one-third again as long as broad, and those following gradually increase in length to the eighth, a transition segment, which is between two and one-half and three times as long as its least width. The segments following gradually decrease in length so that the last 15 or 16 are about as long as broad. The basal portion of the cirri tapers slightly and slowly to the transition segment. The sides of the transition segment converge very slightly to the beginning of the distal third, then diverge to the end. Beyond the transition segment the cirri remain of the same width to the tip. On the transition and following segments the median portion of the distal border dorsally is roughened or armed with exceedingly fine spines. On the succeeding segments it becomes slightly produced and also narrowed, the profile of the outer portion of the cirri being slightly serrate dorsally. The processes almost disappear on the antepenultimate segment. The penultimate segment is usually a truncated cone, with no trace of an opposing spine. The terminal claw is about as long as the penultimate segment; it tapers gradually to a sharp point and is only very moderately curved. The penultimate segment and the terminal claw appear practically as a single unit. Often, however, there is a slight median or subterminal tubercle representing the opposing spine on the penultimate segment, in which case the terminal claw is usually shorter and more strongly curved. The long peripheral cirri, none of which are fully developed, lack the transition segment, and practically all traces of dorsal processes.

The radials are almost entirely, or even quite, concealed by the centrodorsal. The IBr_1 are very short, longer laterally than in the median line, and in contact laterally. The IBr_2 (axillaries) are in the median line three times as long as the IBr_1 or even longer. They are rhombic with truncated lateral angles, and are about half again as broad as long. Their lateral edges converge slightly proximally and are not in contact with those of their neighbors. In the proximal third they bear a fine median elevated line which continues a similar median line on the IBr_1. The IIBr series and IIIBr series (when present) resemble the IBr series. The inner borders of the $IIBr_1$ and of the first brachials may be slightly everted.

The 19 arms are 115 mm. long. Five IIBr series are present, one on each postradial series. Four of the IIBr series bear externally a IIIBr series. All the division series are 2. A very narrow, low, inconspicuous, but always distinct, carinate line runs along the middorsal line of the arms to their tips.

P_1 is 13 mm. long with 20 segments, moderately flexible, tapering gradually and evenly from the base to the tip, which is not especially delicate. The first four segments are about as long as broad and those succeeding are somewhat longer than broad, mostly about half again as long as their proximal width. The first segment has the distal border slightly convex. The second and third segments have the distal dorsal angle extending somewhat beyond the base of the segments succeeding, and in the case of the third somewhat produced. The fourth and following segments have both distal angles extending slightly beyond the base of the segments succeeding, and in the last 8 or 9 segments the sides diverge slightly so that in this portion of the pinnule both the proximal and distal profiles are serrate. The outer surface of the pinnule is rather narrowly rounded.

P_2 is 7 mm. long with 12 segments; it is slightly less stout basally than P_1 and like that pinnule tapers regularly to the tip. The first two segments are slightly broader than long, the third is about as long as broad, and those following are longer than broad, becoming half again as long as broad distally. The distal angles of the segments extend slightly beyond the bases of the succeeding segments, this feature increasing in amount distally, and are armed with exceedingly fine spines. The midline of the outer surface of the pinnule is rather broadly roughened and is slightly elevated, forming a roughened band which can scarcely be called a carination.

P_3 is 5 mm. long with 9 segments; it resembles P_2 and is basally of the same width.

P_4 resembles P_3.

Notes.—The lateral separation of the axillaries and second brachials, the absence of lateral flattening of the division series, and the very small and obscure dorsal processes on the outer cirrus segments give this species superficially much more the appearance of one of the Mariametridae than of a species of Thalassometridae.

Locality.—Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 32; 250 meters; sand; April 22, 1922 (1, C. M.).

PARAMETRA AJAX A. H. Clark

PLATE 9, FIGURE 29

Parametra ajax A. H. CLARK, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 635 (listed), p. 649 (Malay Archipelago; description), pl. 41, figs. 6, 7.

Diagnostic features.—The arms are evenly rounded dorsally, as in *P. fishcri*, and the brachials have the distal edge much thickened and produced and armed with very numerous excessively fine teeth; and the cirri are relatively large and stout, XX, 23–27, about one-quarter of the arm length.

Description.—The centrodorsal is thin discoidal with the very broad dorsal pole rather deeply sunken and finely papillose. The cirrus sockets are arranged in one row and a partial second irregular marginal row.

The cirri are XX, 23–27 (usually nearer the latter), from 20 to 25 mm. in length. The first segment is short and those following gradually increase in length to the fifth or sixth, which is almost or quite as long as broad. The sixth, seventh, or eighth is a transition segment, and is about half again as long as broad. The outer third of the segment is almost white, and the dorsal and ventral profiles of this white portion diverge strongly, the dorsal making a greater angle with the longitudinal axis than the ventral. The segments following decrease in length, after about four becoming about half again as broad as long. The distal edge of the transition segment is rather strongly produced dorsally. On the following segments this production of the distal dorsal edge takes the form of a rather high transverse ridge with the crest flattened and dentate. Distally this ridge gradually narrows and on the last six segments before the penultimate it is transformed into a low submedian dorsal tubercle. The opposing spine is small, conical, with the apex median or subterminal in position. The terminal claw is about as long as the penultimate segment or slightly longer, rather slender, and gently and evenly curved. The cirri increase slightly in width and thickness to the fourth or fifth segment, then decrease to the end of the transition segment, after which point they remain uniform.

The ends of the basal rays are visible as prominent and rather large rounded triangular tubercles in the angles of the calyx.

The radials are wholly concealed. The IBr_1 are chevron shaped, very narrow, with parallel sides, and are in close apposition. In the median line they bear a prominent sharp keel or an elongate tubercle extending the entire length of the dorsal surface. The lateral portions of the distal border may be unmodified, or they may be extended distally over the proximal portion of the axillaries in the form of a thin broadly scalloped flange. The IBr_2 (axillaries) are broadly rhombic, twice as broad as long; the lateral angles are only very slightly truncated. The dorsal surface may rise to a broad rounded prominence in the center with its maximum height in the proximal half, or the proximal third of the median line may be occupied by a broad longitudinally elongate tubercle or a sharp median keel. The IIBr series are 2, resembling the IBr series, rather narrowly convex in the median line, but without central tubercles or keels.

The 20 arms were probably about 90 mm. long. They are very narrow at the base, increasing in width to about the fourteenth brachial and thence gradually tapering distally. The first brachial varies from three times as broad as long in the median line to only half again as broad as long. In the latter case it is wedge-shaped, longer exteriorly than interiorly; in the former the proximal and distal borders are parallel as far as the middorsal line, where the distal border turns anteriorly and runs diagonally outward to the outer distal angle. When very short the first brachials have a prominent elongate tubercle occupying the entire length of the median line, but usually the dorsal surface is evenly convex and swollen so that the profile is strongly convex. The inner distal angles are more or less cut away, as are the inner proximal angles of the second brachials, so that conspicuous rhombic water pores are formed. The second brachials are from two to three times as broad as long, in shape approximately oblong. Their distal edges are slightly prominent. The first syzygial pair (composed of brachials 3+4) is very slightly longer exteriorly than interiorly, usually about half again as broad as long. The hypozygal (third brachial) is oblong, with the distal border raised above the articular line; the epizygal (fourth brachial) is wedge-shaped, longer exteriorly than interiorly, with the distal border prominent. The following eight brachials are wedge-shaped, from three to four times as broad as long in the median line, with the longer side about half again as long as the shorter. Their distal edges are usually raised considerably above the bases of the brachials following, giving the profile of this portion of the arm a serrate appearance; they are also usually somewhat thickened and very finely dentate. The succeeding brachials become triangular, slightly broader than long, with the distal border rather strongly concave and the distal edge strongly thickened and produced and armed with very numerous excessively fine teeth.

P_1 is 7 mm. long and is composed of 17 segments. It is moderately stout at the base, but tapers rather rapidly in the first nine segments and becomes slender from that point onward. The first two segments are about twice as broad as long and those following gradually increase in length, becoming about as long as broad on the fifth and sixth, and somewhat more than twice as long as broad distally. The segments are sharply carinate.

P_2 is 9.5 mm. long with 18 segments. It is not quite so stout basally as P_1 and tapers much more gradually. The segments are at first broader than long, becoming about as long as broad on the fourth and twice as long as broad in the outer portion. The segments are sharply carinate, and in the distal half this carination is high and the distal angle is distally produced, considerably overlapping the base of the segment succeeding.

P_3 is 8.5 mm. long with 15 segments. It is about as broad basally as P_2, but tapers very gradually and evenly to the tip so that in its distal half it is twice as broad as P_2. The segments become as long as broad on the eighth and are distally about half again as long as broad.

P_4 is 9 mm. long with 16 segments, resembling P_3 but tapering still more gradually and hence broader throughout with relatively shorter segments.

On some arms P_1 may be twice as broad basally as P_2, though becoming more slender in the distal half, while on others there is very little difference between them. On the other arms P_1 and P_2 may be relatively small, the former very slightly stouter basally than the latter, and P_3 may be much longer and broader than either.

Locality.—Malay Archipelago; from a cable; cable repair ship *Patrol*, Eastern and Associated Telegraph Co. [A. H. Clark, 1929] (1, B.M.).

PARAMETRA FISHERI (A. H. Clark)

PLATE 9, FIGURE 28

[See also vol. 1, pt. 1, fig. 365, p. 297; pt. 2, fig. 218, p. 164.]

Thalassometra fisheri A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 214 (in key), p. 223 (description; *Albatross* station 4122).

Parametra fisheri A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 16 (listed); Crinoids of the Indian Ocean, 1912, p. 213 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 158 (in key; range; references); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 649 (compared with *P. ajax*); Bernice P. Bishop Mus. Bull. 195, 1949, p. 74 (*Albatross* station 4122), p. 111 (station data).

Diagnostic features.—The arms are evenly rounded dorsally; P_1 is basally much enlarged, tapering to a slender distal portion; and the cirri are rather long, about one-quarter of the arm length, with the transition segment the fifth and the distal segments about as long as broad with prominent dorsal spines. The 13 arms are 110 mm. long, and the cirri are 20–25 mm. long with 19–26 segments.

Description.—The centrodorsal is low hemispherical with a rather large polar area bare. The cirrus sockets are arranged in 2 irregular marginal rows and 2 irregular columns in each radial area.

The cirri are XV, 19–26 (usually nearer the latter) from 20 mm. to 25 mm. in length. The first 2 segments are short, the third is not quite so long as broad, the fourth is rather longer than broad, and the fifth, a transition segment, is somewhat over twice as long as broad with the distal third highly polished. The next segment is about half again as long as broad and those following decrease in length, after 3 or 4 becoming about as long as broad and so remaining to the penultimate. The transition segment and all the segments following bear prominent and sharp dorsal spines. The opposing spine is blunt, and very small or obsolete. The terminal claw is longer than the penultimate segment, and is relatively little curved.

The disk is unplated. The brachial ambulacra have well-developed plates. The pinnule ambulacra have well-developed side and covering plates. Sacculi are abundant, large on the brachial ambulacra, and small on the pinnules.

The ends of the basal rays are visible as small tubercles in the interradial angles of the calyx.

The radials are concealed by the centrodorsal. The IBr_1 are short, about 4 times as broad as long, smooth, with the dorsal surface somewhat convex and bearing a large low rounded tubercle in the median line. It is slightly chevron-shaped. The IBr_2 (axillaries) are rhombic or almost low triangular, about twice as broad as long, with the dorsal surface moderately convex. The IIBr series are 2, resembling the IBr series.

There are 13 arms in the type which are 100 mm. long. The first 2 brachials are slightly wedge-shaped with the longer side out. The first syzygial pair (composed of brachials 3+4) is rather less than twice as broad as long, with the hypozygal about twice as long as the epizygal. The following brachials are oblong or slightly wedge-shaped, about twice as broad as long, after the twelfth becoming obliquely wedge-shaped and about as long as broad. The arms are rounded dorsally and the distal ends of the brachials are prominent, though there is no overlapping.

Syzygies occur between brachials 3+4, again from between brachials 13+14 to brachials 16+17, and distally at intervals of from 3 to 5 (most commonly 4) muscular articulations.

P_1 is 7 mm. long with 16 segments the first 3 of which are rather disproportionately large, about as broad as long, with broad and spinous dorsal keels, the remainder being smaller and more slender, and longer than broad. P_2 is 6 mm. long, more slender than P_1 and tapering evenly from the base, with the basal segments not differentiated from the others. It is composed of 14 segments of which the first 2 are about as long as broad and those following slowly become elongated. The segments are slightly carinate and are broader at their distal than at their proximal ends so that the pinnule has a notched outline. The following pinnules are similar, but decrease in length to P_5 and then gradually increase distally, reaching a length of 8.5 mm. The distal pinnules have the first segment short, the second about as long as broad, and the remainder gradually becoming elongated, though the length never exceeds twice the width. The distal ends of the segments are somewhat overlapping.

Locality.—*Albatross* station 4122; Hawaiian Islands; Barber's Point Light (near Honolulu) bearing N. 82° E., 2.2 miles distant; 351–643 meters; coarse coral sand and shells; July 26, 1902 [A. H. Clark, 1908, 1909, 1912, 1918, 1929, 1949] (1, U.S.N.M., 22686).

History.—This species is as yet known only from the type specimen described under the name of *Thalassometra fisheri* in 1908 and transferred to the genus *Parametra* in 1909.

Genus LISSOMETRA A. H. Clark

Antedon (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 145.

Thalassometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360.

Parametra (part) A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 214.

Lissometra A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 147 (in key; range), p. 160.—Gislén, Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Diagnosis.—A genus of Thalassometridae in which there is no appreciable expansion of the earlier segments of the genital pinnules; the middle and distal brachials are somewhat compressed laterally and have an ill-defined median keel, but the division series and arm bases are rounded dorsally with a strong median crest; the IIBr series are 2; and the cirri are about one-third of the arm length with 30–34 segments. In the only known species the 13–15 arms are 65 mm. long, and the cirri are 20 mm. long.

Geographical range.—Known only from the Eastern Sea off Kagoshima Gulf, southwestern Japan.

Bathymetrical range.—Known only from 188 meters.

History.—The single species in this genus was described under the name *Antedon alboflava* in 1907. Later in the same year, upon the establishment of the genus *Thalassometra*, it was transferred to it. In 1912 it was listed as a species of *Parametra*. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *Lissometra alboflava* was listed under the genus *Lissometra* without any explanation; the characters of the new genus were given in a key to the genera of the subfamily Thalassometrinae.

LISSOMETRA ALBOFLAVA (A. H. Clark)

Plate 11, Figure 34

[See also vol. 1, pt. 1, figs. 199, 200, p. 239; pt. 2, fig. 216, p. 161.]

Antedon alboflava A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 145 (description; *Albatross* station 4936).

Thalassometra alboflava A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 318 (Japan).

Parametra alboflava A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 214 (synonymy; locality); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance).

Lissometra alboflava A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 160 (references).

Description.—The centrodorsal is roughly hemispherical or bluntly conical, about as broad at the base as high. The cirrus sockets are arranged in 15 crowded columns, 1 or 2 in each column.

The cirri are X–XV, 30–34, 20 mm. long. Only the fifth, or fifth and sixth, segments are longer than broad. The sixth and following segments bear sharp dorsal spines. The first 5 segments are dark in color with a dull surface and the remainder are nearly white with a polished surface, the transition taking place on the distal end of the fifth segment. The cirri are stout basally, but taper somewhat rapidly to the distal end of the third segment after which point they remain slender.

The disk is scantily plated. The brachial ambulacra are nearly naked. The covering plates on the pinnules are small. The sacculi are numerous.

The ends of the basal rays are just visible as minute tubercles in the interradial angles of the calyx.

The radials are visible as small paired tubercles in the interradial angles. The IBr$_1$ are very short, deeply incised by the axillaries, and strongly carinate. The IBr$_2$ (axillaries) are short, broad, over twice as broad as long, and strongly carinate. The IIBr series resemble the IBr series, but the 2 elements are relatively slightly longer.

The arms are 13 or 15 in number, 65 mm. long, with about 110 brachials of which the first 8 or 9 are oblong and the following are triangular, not quite so long as broad, becoming elongate distally. The brachials in the distal two-thirds of the arm overlap more or less. The elements of the IBr and IIBr series and the first 9 or 10 brachials are sharply flattened laterally and are in close lateral apposition. The middle and distal brachials are somewhat compressed laterally and have an ill defined median keel.

P$_1$ is 6 mm. long, longer and stouter than the succeeding pinnules though not markedly so, with 12 segments which are about as long as broad and are flattened exteriorly. The following pinnules decrease gradually in length to P$_5$ or P$_6$ which is 3 mm. long with 7 short segments, then become gradually longer again, reaching distally a length of 8 mm. with 17 or 18 rather short segments, of which the first is short and broad and the second trapezoidal.

Locality.—*Albatross* station 4936; Eastern Sea, off Kagoshima Gulf; Sata Misaki Light bearing N. 21° E., 5.7 miles distant (lat. 30°54′30″ N., long. 130°37′30″ E.); 188 meters; stones; August 16, 1906 [A. H. Clark, 1907, 1908, 1912, 1915, 1918] (2, U.S.N.M., 22634 [type], 35594).

History.—This species was originally described under the name *Antedon alboflava* from two specimens from *Albatross* station 4936 in 1907, the specimens having been dredged in the year previous. Later in 1907 it was transferred to the new genus *Thalassometra*, and it was included as *Thalassometra alboflava* in a list of the crinoids of Japan published in 1908. In my memoir on the crinoids of the Indian Ocean published in 1912 this species was listed as *Parametra alboflava*, and the synonymy and range were given. The significance of the range was discussed in a paper published in 1915. In my report upon the unstalked crinoids of the *Siboga* expedition published in 1918 this species was listed as *Lissometra alboflava* and the original reference was cited.

Genus CROTALOMETRA A. H. Clark

Antedon (part) Bell, Marine investigations in South Africa, vol. 4, 1905, p. 141, and following authors.

Thalassometra (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126.

Crotalometra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 80 (name used in the description of *C. rustica*); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 403 (diagnosis; genotype *C. eupedata*); vol. 40, 1911, p. 12 (occurs in deep water in the Atlantic, but never intrudes on the territory of the Polar-Pacific species), p. 13 (common to southeastern Africa and the Bay of Bengal, but not found in the Arabian Sea); Crinoids of the Indian Ocean, 1912, p. 10 (absent from Japan), p. 24 (range), p. 59 (in key), p. 209 (original reference; type); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1914, pp. 4 and following (occurs in both Atlantic and Pacific; range); Die Crinoïden der Antarktis, 1915, p. 164 (range), p. 181 (both Atlantic and Pacific; range in each); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 148 (in key; range; key to the included species); Univ. Iowa Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 13 (West Indies and Indo-Pacific), p. 19 (in key); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range).—Gislén, Vid. Medd. Dansk Naturh Foren. København, vol. 83, 1927, p. 6.—Mortensen, Handbook of the echinoderms of the British Isles, 1927, p. 25 (Atlantic species; in key).—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 654.—Gislén, Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 22; Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, Oct. 3, 1938, p. 5.

Diagnosis.—A genus of Thalassometridae in which the arms are dorsally rounded to the tip; the arms in fully developed individuals are more than 15 (normally 20) in number, with the IIBr series 4(3+4), exceptionally 2; the division series are smooth and without spines though the lateral edges of the ossicles may be everted and tubercular or serrate; the first syzygy following a IIBr 4(3+4) series is between brachials 3+4; the cirri are recurved distally, the outer segments carinate or with dorsal spines; and the genital pinnules are not appreciably expanded. All the included species are large, full sized individuals having the arms 110–160 mm. long.

Geographical range.—From Formosa (Taiwan) and the Philippine Islands southward to the Moluccas and westward to the Maldive and Laccadive Islands and southeastern Africa from Durban to Port Elizabeth.

Bathymetrical range.—From 55 to 2,047 meters.

Remarks.—When fully developed the species of *Crotalometra* are quite distinctive and are not easily confused with the species of any other genus, the large size, 20 or about 20 arms with the IIBr series 4(3+4), and the long and stout cirri giving them a characteristic appearance. Much depends, however, on the condition of the preserved specimen. If the arms are extended parallel with each other so that the division series are fully visible and in contact a specimen of any of the species is unmistakable. If, however, the arms are recurved over the centrodorsal the appearance changes completely so that in most cases an analysis of the characters becomes necessary.

Three species of *Crotalometra* are recognized herein—*sentifera*, *rustica*, and *magnicirra*. As synonyms under *rustica* are included *infelix*, *marginalis*, and *eridanella*, the type specimens of which do not seem to differ from *rustica* to any significant degree.

The only reliable feature for specific differentiation in the genus *Crotalometra* appears to be the relative production of the distal dorsal edge of the outer brachials.

History.—The first known species of *Crotalometra* was described under the name of *Antedon magnicirra* by Prof. F. Jeffrey Bell in 1905. At the time I published my first revision of the genus *Antedon* in 1907 I had not been able to consult the description of *Antedon magnicirra*, but in a paper published on April 11, 1908, I referred it to the genus *Thalassometra*. The generic name *Crotalometra* was first used in a paper published on April 17, 1909, in the combination *Crotalometra rustica*, sp. nov., under which heading this species was described. The genus *Crotalometra* therefore dates from this appearance of the name, with *C. rustica* as the genotype. In a paper on new Philippine crinoids published on May 13, 1909, but submitted for publication in advance of the paper just cited, the new genus *Crotalometra* is diagnosed, and the genotype is given as *C. cupedata*, new species, the description of which follows. Under *Crotalometra* I said:

> Carpenter's *Antedon valida*, the systematic position of which has puzzled me greatly, belongs to this genus, and is closely related to *C. cupedata*, though apparently perfectly distinct; *Antedon incerta* also should be referred to this genus. The *Antedon magnicirra* described from South Africa by Professor Bell is likewise a member of this genus, and I have examined two or three additional species from the East Indian region.

In a paper on the Recent crinoids of the coasts of Africa published on March 15, 1911, I listed and gave the ranges of *Crotalometra magnicirra*, *C. porrecta*, and *C. flava* (the last two herein referred to the new genus *Koehlermetra*). In my memoir on the crinoids of the Indian Ocean published in 1912 I gave the range of *Crotalometra* as from the Kermadec and Meangis Islands to the Philippines in 340–630 fathoms, and listed under the genus, with the synonymy and ranges, *C. eupedata*, *C. propinqua*, *C. valida*, and *C. incerta*, accepting *Crotalometra* in the sense of its formal description instead of its first appearance. Under *Thalassometra* were listed *Th. magnicirra*, *Th. rustica*, *Th. sentifera*, and *Th. infelix*, herein referred to *Crotalometra*. In a paper on the crinoids of the British Museum published in 1913 there appears the heading "Genus *Aglaometra* A. H. Clark" under which are given notes on *Aglaometra valida* and *A. incerta*.

The genus *Aglaometra* is inserted in a key to the genera of the subfamily Thalassometrinae in my memoir on the unstalked crinoids of the *Siboga* expedition, and a key to the included species (*vera*, *propinqua*, *sulcata*, *eupedata*, *valida*, and *incerta*) is given. These 10-armed forms are therefore definitely removed from the genus *Crotalometra*, which in the *Siboga* report is given as including *C. flava*, *C. porrecta*, *C. sentifera*, *C. rustica*, *C. marginalis*, and *C. magnicirra*. Since the publication of the *Siboga* report the status of the genus *Crotalometra* has remained unchanged. In the present work the two Atlantic species, *porrecta* and *flava*, which differ markedly from the Indo-Pacific forms, are set apart as constituting the new genus *Koehlermetra*.

KEY TO THE SPECIES IN THE GENUS CROTALOMETRA

a^1. Brachials beyond the proximal third of the arms with the central portion of the distal dorsal edge produced into long overlapping spines which are more or less flattened dorsoventrally and rounded or truncate at the tip; 12–19 arms 150–160 mm. long; cirri 40–50 mm. long with 51–62 segments (Maldive and Laccadive Islands; 914–1,265 meters) ---------------- **sentifera** (p. 91)

a^2. Brachials beyond the proximal third of the arms not produced into long overlapping dorsal spines.

  b^1. Brachials beyond the proximal third of the arms strongly overlapping, the central portion of the distal dorsal edge somewhat produced and spinous; 13–20 arms 90–150 mm. long; cirri 55–85 mm. long with 45–70 segments (Moluccas and the Malay Archipelago to Formosa and Madras; 55–2,047 meters) -- **rustica** (p. 91)

  b^2. Brachials beyond the proximal third of the arms with the distal borders unmodified, or at least not conspicuously modified; 16–20 (usually 20) arms 75–110+mm. long; cirri 55–70 mm. long with 50–63 segments (southeastern Africa from Durban to Port Elizabeth; 91–731 [?823] meters) -- **magnicirra** (p. 97)

CROTALOMETRA SENTIFERA A. H. Clark

Plate 32, Figures 100–103

Crotalometra sentifera A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 147 (description; lat. 10°47′45″ N., long. 72°40′20″ E., 703 fms.); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 551 (compared with *C. infelix*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 149 (in key; range; references); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 654 (compared with *C. eridanella*, sp. nov. [=*C. rustica*]); John Murray Exped. 1933–34, Sci. reports, vol. 4, No. 4, 1936 (January 1937), p. 87 (listed), p. 92 (*Mabahiss* station 158; notes; range), pp. 98, 101, 103.

Thalassometra sentifera A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 201 (synonymy; description; locality), fig. 37, p. 202.

Diagnostic features.—The brachials of the middle and outer portions of the arms have the central portion of the distal edge produced into long and conspicuous more or less dorsoventrally flattened overlapping spines. The 12–19 arms are 150–160 mm. long, and the cirri are 40–50 mm. long with 51–62 segments.

Description.—The cirri are XX, 59–62, 50 mm. long.

The 12–16 arms are from 150–160 mm. long. After the proximal third of the arm the brachials bear long overlapping spines which are more or less flattened dorsoventrally and rounded or truncated at the tip.

In characters other than those mentioned this species resembles *C. magnicirra* and *C. rustica*.

Notes.—One of the specimens from *Mabahiss* station 158 has 18 or 19 arms. The cirri are about 40 mm. long with 51–55 segments; the eighth is a transition segment. On the centrodorsal the pairs of columns of cirrus sockets are separated in the midradial line by a broad and rather deeply concave bare area. The proximal edge of the IBr_1, the proximal and distal edges of the IBr_2, and the proximal edge of the IIBr_1 are everted and armed with a few short coarse spines.

The second specimen is similar, with 15+ arms. The longest cirri are 47 mm. long, with 61–63 segments. The transition segment is the eighth. The pairs of cirrus sockets are separated by a broad midradial space. The dorsal pole of the centrodorsal is papillose.

Localities.—*Investigator* station 124; Laccadive Islands (lat. 10°47′45″ N., long. 72°40′20″ E.); 1,265 meters; large water-worn fragments of reef coral [A. H. Clark. 1909, 1911, 1912, 1918, 1937] (2, U.S.N.M., 35582; I. M.).

Mabahiss station 158; Maldive Islands (lat. 4° 42′30″ to 4°36′48″ N., long. 72°42′30″ to 72°48′54″ E.); 914 meters; April 7 1934 [A. H. Clark, 1937] (2, B. M.; Cairo Mus.).

Geographical range.—From the Maldive to the Laccadive Islands.

Bathymetrical range.—From 914 to 1,265 meters.

History.—This species was first described in 1909 under the name *Crotalometra sentifera* from two specimens collected by the Royal Indian Marine Survey Steamer *Investigator* at station 124 in the Laccadive Islands. In 1911 *Crotalometra sentifera* was compared with the new species *C. infelix*. In 1912 this species was redescribed and figured under the name of *Thalassometra sentifera*. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *sentifera* was included in the key to the species of *Crotalometra*, and the synonymy and range were given. In 1937 two additional specimens of *Crotalometra sentifera* were recorded and described that had been dredged at station 158 in the Maldive area by His Egyptian Majesty's steamer *Mabahiss* operating under the auspices of the John Murray Expedition to the Indian Ocean, 1933–34.

CROTALOMETRA RUSTICA A. H. Clark

PLATE 11, FIGURES 35, 36; PLATE 18, FIGURE 58

[See also vol. 1, pt. 2, fig. 283, p. 215.]

Crotalometra rustica A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 80 (description; Malay Archipelago, 30 fathoms), p. 147 (related to *C. sentifera*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 149 (in key; range; references); Ann. Mag. Nat. Hist., ser. 10, vol. 10, No. 58, October 1932, p. 378 (listed), p. 383 (off Madras; 600 fathoms; notes), pl. 15.

Crotalometra infelix A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 550 (description; *Albatross* station 5317); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 149 (identity).

Thalassometra rustica A. H. CLARK, Zool. Anz., vol. 39, No. 11/12, 1912, pp. 424, 425 (compared with *marginalis*); Crinoids of the Indian Ocean, 1912, p. 198 (synonymy; detailed description; locality), fig. 36, p. 199.

Thalassometra marginalis A. H. CLARK, Zool. Anz., vol. 39, No. 11/12, 1912, p. 424 (description; *Siboga* station 226).

Thalassometra infelix A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 203 (synonymy; locality).

Crotalometra marginalis A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 149 (in key; range), p. 150 (detailed description; station 226), p. 274 (listed), pl. 23, fig. 62.—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8 (probably a large specimen of *C. magnicirra*).

Crotalometra eridanella A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 635 (listed), p. 654 (off Great Nicobar, 1,040–1,120 fathoms; description), pl. 42, fig. 9.

Crotalometra marginata Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 23.

Diagnostic features.—The brachials of the middle and outer portions of the arms have the central portion of the distal edge somewhat produced and spinous. The 13–20 arms are 90–150 mm. long, and the cirri are 55–85 mm. long with 45–70 segments.

Description.—The centrodorsal is apparently as in *C. magnicirra*, with the cirrus sockets arranged in 10 columns, two in each radial area.

The cirri are XX, about 70 (69 to broken tip), 85 mm. long, large and stout. The first three segments are subequal, about three times as broad as long, the fourth is slightly longer, the fifth is about as long as broad or slightly longer than broad, and those following are about one-third again as long as broad, becoming as long as broad after the eighteenth and after four or five more about twice as broad as long. The eighteenth is a transition segment. Following the transition segment the dorsal surface of each segment gradually rises into a subterminal dorsal tubercle which, however, never projects in the form of a spine. The tubercle is at first rather broad transversely and rounded dorsally, but distally it becomes narrower so that the dorsal surface of the segment becomes bluntly carinate. Viewed laterally the dorsal profile of the cirri presents a slightly serrate appearance.

The ends of the basal rays are visible as prominent dorsoventrally elongated tubercles in the interradial angles of the calyx.

The radials project very slightly beyond the rim of the centrodorsal. The IBr_1 are very short and bandlike, about five times as broad as long, with the proximal border convex and the distal concave, and are in close lateral apposition. The IBr_2 (axillaries) are broadly pentagonal, half again as broad as long, with all the sides strongly concave. The lateral borders of the two components of the IBr series taken together are evenly and strongly concave, the proximal width of the IBr_1 and the distal width of the IBr_2 being about the same. Both these ossicles are sharply flattened laterally with the apposed edges somewhat everted. The IIBr series are 4(3+4), very strongly rounded dorsally like the IBr series, in close lateral apposition and sharply flattened against their neighbors. The lateral edges are somewhat produced. The elements of this division series are relatively rather long.

The 20 arms are about 150 mm. long, deep and laterally compressed, and strongly rounded dorsally. The first brachials are very short and strongly concave distally. The second brachials are much larger with a posterior process incising the first. The first syzygial pair (composed of brachials 3+4) is about as long as broad with the dorsal and lateral profiles concave as in the syzygial pair formed by the two distal elements of the IIBr series. The following brachials to the ninth are wedge-shaped, half again as broad as long. The brachials following are triangular, about as long as broad, in the terminal portion of the arm becoming wedge-shaped again and slightly longer. After the proximal third of the arm the brachials develop prominent and spinous distal ends and a striated dorsal surface.

Syzygies occur between brachials 3+4, again from between brachials 15+16 to between brachials 19+20, and distally at intervals of from 4 to 9 muscular articulations.

P_D is 15 mm. long, large and stout in the basal half but tapering to a slender tip, composed of about 25 segments of which the second-seventh are broader than long and the remainder are about as long as broad. P_1 is 12 mm. long with 23 segments, much less stout than P_D, with the distal segments somewhat spinous along the dorsal ridge. P_3 is 7 mm. long, considerably more slender than P_2, tapering evenly from the base to the end of the proximal half, slender in the distal half, composed of 16 segments all but the first two of which are about as long as broad. The following pinnules are of about the same length but scarcely taper at all until near the tip and hence appear somewhat stouter; they are composed of about 14 segments. The distal pinnules are moderately slender, 12 mm. long with 20 segments of which the first is trapezoidal, about twice as broad distally as the median length, the second is trapezoidal, somewhat broader distally than the median length, and the remainder are slightly longer than broad; the dorsal ridge is very sharp and more or less spinous.

The color in alcohol is white.

Notes.—The preceding description is based upon the type specimen in the Indian Museum at Calcutta from the Malay Archipelago in 30 fathoms.

The specimen from *Albatross* station 5317 was described as a new species, *Crotalometra infelix*, in the following terms. The centrodorsal is low-conical with the apex abruptly prolonged. The cirrus sockets are arranged in 10 closely crowded columns.

The cirri are XX, 38–44, from 25 to 30 mm. long. The first segment is short and those following gradually increase in length becoming about as long as broad on the fifth and half again as long as broad on the seventh. The segments following gradually decrease in length becoming about as long as broad on the eleventh and from half again to twice as broad as long distally. The eighth and following segments have produced distal dorsal edges which soon become prominent dorsal spines.

The ends of the basal rays are visible in the interradial angles of the calyx as dorsoventrally elongate tubercles.

The radials are short, about four times as broad as long, with a prominent median tubercle. The IBr_1 are broader proximally than distally, and about twice as broad distally as long in the mid-dorsal line; they bear a low broadly rounded median carination which is most prominent posteriorly. The IBr_2 (axillaries) are rhombic, half again as broad as long; the proximal two-thirds of the median dorsal line is raised into a low broad tubercle. The IIBr series are 4(3+4).

The 13 arms are 90 mm. long. After the proximal third the brachials gradually develop produced and overlapping spinous distal edges, at the same time becoming laterally compressed. After the proximal half this production of the distal edge becomes very prominent, especially in the median line.

I said that this species is nearest to *C. sentifera*, but the centrodorsal is proportionately much smaller and bears closely crowded columns of cirrus sockets without bare midradial areas, the edges of the elements of the IBr series are smooth instead of finely dentate, the IBr_1 has a distinct, though low, rounded median carination, and the distal overlap of the brachials, though very prominent, is not produced into the long overlapping spine characteristic of *C. sentifera*. I added that the type of *C. infelix* is a small specimen and that larger specimens may prove to approach *C. sentifera*, "though it seems most probable that the two forms are quite distinct."

The specimen from off Madras has 17 arms 120 mm. long, 7 IIBr 4(3+4) series being present. One of the postradial series is in process of adolescent autotomy. The cirri have 62–68 segments and are up to 63 mm. in length. I noted that this specimen seems without any doubt to be a young example of *C. rustica.*

Two specimens from *Siboga* station 226 were described as a new species under the name of *Thalassometra marginalis.* Their characters were as follows:

The centrodorsal is low, rounded conical. The cirrus sockets are arranged in 10 columns of 2 each, the two columns of each radial area being in close contact with those of adjacent radial areas but separated interiorly by a bare triangle basally about half as wide as a cirrus socket that comes to a point just beyond the last functional socket and is continued thence as a narrow line to the dorsal pole.

The cirri have 60 segments and are 50 mm. long.

The ends of the basal rays are very prominent as high dorsoventrally elongate tubercles which are usually rather longer than the dorsoventral length of a cirrus socket.

In one specimen a small portion of the lateral end of the radials is visible as two elongate tubercles meeting in a triangle over the ends of the basal rays. The proximal borders of the IBr_1 are produced into a narrow rim that projects downward over the radials almost or quite concealing them, but cut away in the interradial angles to accommodate the ends of the basal rays.

One of the specimens has 17 arms about 95 mm. long; two of the IIBr series are 2 and five are 4(3+4). The other, of the same size, has 18 arms with all eight IIBr series 4(3+4).

I wrote that the two individuals of *Thalassometra marginalis* have about half the arm and cirrus length of *Crotalometra rustica,* though apparently they represent a species very closely related to it, and also to *C. magnicirra.* The new species was supposed to differ from *C. rustica* in having the proximal edge of the IBr_1 produced downward into a narrow rim that projects over the radials entirely, or almost entirely, concealing them. In the interradial angles the IBr_1 are cut away to accommodate the basal rays, whereas in *C. rustica* they are separated from the basal rays by the radials, which form a continuous band all around the calyx. These differences are scarcely of specific importance.

A specimen from off Great Nicobar in 1,040–1,120 fathoms was described as a new species under the name of *Crotalometra eridanella* as follows:

The centrodorsal is hemispherical. The cirrus sockets are arranged in 10 columns, usually three to a column. There are two columns in each radial area, one along each side, each of these closely crowded against the adjacent column in the adjoining radial area. The central portion of each radial area is occupied by a bare sunken strip which is somewhat less in width that the breadth of the adjacent cirrus sockets.

The cirri are about XXV, 45–57, large and stout, probably from 55 to 60 mm. in length. The first segment is very short and those following increase in length to the sixth, which is about as long as broad, or slightly longer than broad, and increase still further to the tenth, a transition segment, which is about half again as long as broad. From the eleventh onward the segments gradually decrease in length so that those in the terminal third of the cirri are about twice as broad as long. On the tenth the dorsal portion of the distal edge is slightly produced, and as the segments become shorter this production of the distal edge extends proximally and at the same time rises so that the short distal segments have a high dorsal carination with the rather abruptly rounded apex subterminal in lateral view. In lateral view the cirri are stout basally, tapering noticeably in the first six or eight segments, increasing slightly in width beyond the tenth, and in the distal fourth tapering to a small tip.

The radials and part of the IBr_1 are concealed by the centrodorsal which in the interradial angles is extended anteriorly so as almost or quite to meet the lateral angles of the axillaries. The IBr_1 are short and crescentic, incised in the median line by the backward extension of the axillaries and with the lateral borders reduced to a point. The IBr_2 (axillaries) are broad, rhombic, twice as broad as long, with the lateral angles truncated and the short sides thus formed flattened against those of the adjacent ossicle. Of the four IIBr series present two are 4(3+4) and two are 2. They are well rounded dorsally, but are in lateral contact. The borders and dorsal surface of the elements of the division series are entirely smooth, and there is only a very slight elevation at the synarthries.

The 14 arms were probably about 140 mm. long. The earlier brachials are broadly and evenly rounded dorsally and entirely smooth, with only a very slight eversion of the ends which is very minutely, if at all, spinous. The position of the articular tubercles is faintly indicated. After the brachials become triangular the production of the distal border becomes more marked and more prominently spinous, and on the brachials in the outer half of the arm there is a strong spinous overlap and the central portion of the distal edge of the brachials may bear an abrupt tuft or fin of rather long spines.

P_1 is 12 mm. long with 20 segments; it is fairly stout at the base and tapers evenly to a slender tip. The segments become about as long as broad on the fifth, and twice as long as broad on the thirteenth. The small elongated distal segments have spinous ends.

P_2 is 7 mm. long with 15 segments, proportionately smaller than P_1. The segments become as long as broad on the third or fourth, and twice as long as broad on the tenth.

P_3 is shorter and less stout basally than P_2.

The distal pinnules are 12 mm. long with 20 or 21 segments, of which the first is short, the second is half again as broad as long, the third is about as long as broad, and the outer are twice as long as broad. The dorsal keel on the segments is sharp and rather coarsely spinous, and there is a little tuft of spines at the end of each segment.

In diagnosing this supposed new species I said that it is a species of *Crotalometra* in which the cirri, which are large and stout and composed of 45–57 segments, are arranged in 10 columns on the centrodorsal; the brachials beyond the proximal third of the arms have the distal edges strongly overlapping, the central portion of the distal edge often bearing an abrupt tuft or fin of rather long spines (more or less as in *C. sentifera*).

Localities.—Siboga station 226; Moluccas; midchannel between the Lucipara and Schildpad Islands (lat. 5°26′42″ S., long. 127°36′30″ E.); 1,595 meters; hard bottom, only small stones in the dredge; November 11 and 12, 1899 [A. H. Clark, 1912, 1918; Gislén, 1928, 1934] (2, Amsterdam Mus.).

Investigator; Malay Archipelago; 55 meters [A. H. Clark, 1909, 1912, 1918] (1, I. M.).

Albatross station 5317 (listed in the dredging records as 5517); China Sea in the vicinity of Formosa (Taiwan) (lat. 21°36′00″ N., long. 117°27′00″ E.); 420 meters;

sand and small shells; November 5, 1908 [A. H. Clark, 1911, 1912, 1918] (1, U.S.N.M., 27499).

Off Great Nicobar Island (lat. 6°15′ N., long. 93°35′ E.); 1,901–2,047 meters; cable repair ship *Patrol*, Eastern and Associated Telegraph Co. [A. H. Clark, 1929] (1, B. M.).

Off Madras (lat. 12°53′ N., long. 80°45′ E.); 1,097 meters; cable repair ship *The Cable*, Eastern Australasia and China Telegraph Co., through A. A. Davison [A. H. Clark, 1932] (1, B. M.).

Geographical range.—From the Moluccas and the Malay Archipelago northward to Formosa (Taiwan) and northwestward to Madras.

Bathymetrical range.—From 55 to 2,047 meters.

History.—This species was first described in 1909 under the name of *Crotalometra rustica* from a single badly broken specimen that had been dredged by the Royal Indian Marine Survey steamer *Investigator* in the Malay Archipelago in 30 fathoms. In 1911 I described under the name of *Crotalometra infelix* a small individual that undoubtedly belongs to the same specific type. In 1912 I described *Thalassometra marginalis* from two specimens from *Siboga* station 226, and in my memoir on the crinoids of the Indian Ocean published toward the end of the year I redescribed and figured *Thalassometra rustica* and listed *Th. infelix* with the synonymy and range. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 I listed *Crotalometra rustica*, under which I placed *Crotalometra infelix* as a synonym, and redescribed and figured *Crotalometra marginalis*.

When giving some notes on *Crotalometra magnicirra* in 1928 Prof. Torsten Gislén said that *C. marginalis* is probably a large specimen of this species.

In 1929 I described and figured *Crotalometra eridanella* from a specimen from off Great Nicobar Island that had been brought up on a cable from a depth of 1,040–1,120 fathoms by the cable repair ship *Patrol* of the Eastern and Associated Telegraph Company. In 1932 I recorded and figured *C. rustica* from a specimen from off Madras in 600 fathoms that had been found on a cable brought to the surface by the cable repair ship *The Cable* of the Eastern Australasia and China Telegraph Co. and had been sent to the British Museum by A. A. Davison.

Professor Gislén discussed certain features of the structure of *Crotalometra marginata* in 1934.

CROTALOMETRA MAGNICIRRA (Bell)

Antedon magnicirra Bell, Marine investigations in South Africa, vol. 4, 1905, p. 141 (description; localities), pl. 4, figs. 1–3.—A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (belongs to the genus *Thalassometra*); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 482 (systematic position); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 18 (not placed in a revision of the Thalassometridae); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 404 (referred to *Crotalometra*); vol. 40, 1911, p. 5 (=*Crotalometra magnicirra*); Crinoids of the Indian Ocean, 1912, p. 41 (identity); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 84 (B. M., MS.=*sclateri*).

Antedon magnicirrus Bell, Marine investigations in South Africa, vol. 4, 1905, p. 142 (editorial error).

Antedon magnicrinus Bell, Marine investigations in South Africa, vol. 4, 1905, pl. 4 (editorial error).

Thalassometra magnicirra A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126; Proc. U. S. Nat. Mus., vol. 34, 1908, p. 482; Amer. Nat., vol. 42, No. 500, 1908, p. 542 (characteristic oceanic species); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (same); Zool. Anz., vol. 39, No. 11/12, 1912, p. 424 (compared with *Th.* [*Crotalometra*] *marginalis*); Crinoids of the Indian Ocean 1912, p. 41 (identity), p. 198 (synonymy; locality).

Crotalometra magnicirra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 80 (compared with *C. rustica*); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 147 (related to *C. sentifera*); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 5 (identity), p. 8 (locality), p. 36 (synonymy; localities in detail); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 45 (published references to specimens in the B. M.; stations 12792 and 12885/6; characters of the cirri and centrodorsal); Die Crinoïden der Antarktis, 1915, p. 164 (represents the family Thalassometridae in South Africa; range); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 149 (in key; range), p. 150 (synonymy).—H. L. Clark, Ann. South African Mus., vol. 13, pt. 7, No. 12, 1923, p. 234 (synonymy: locality).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8 (*C. marginalis* probably a large specimen of this species).—A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936 (January 1937), p. 101 (range), p. 105.—Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, Oct. 3, 1938, pp. 4, 17 (localities; notes).

Diagnostic features.—The brachials of the middle and outer portions of the arms have the distal edges unmodified, or at least not conspicuously modified. The 16–20 (usually 20) arms are 75–110+ mm. long, and the cirri are 55–70 mm. long with 50–63 segments.

Description.—On the centrodorsal the cirrus sockets are arranged in 10 columns, with the two columns in each radial area separated from each other by a midradial furrow.

The cirri are XV-XXV, 50–63, from 55 to 70 mm. long; the eighth or ninth is a transition segment.

The IIBr series are 4(3+4), exceptionally 2. The margins of the elements of the IBr series may be smooth or everted and finely denticulate; these ossicles may have an indistinct longitudinal carination.

The 16–20 (usually 20) arms are from 75 to 110+ mm. long.

Notes.—This species has never been adequately described, and no specimens are available for redescription. The description given above was compiled from scattered notes, chiefly by Professor Gislén.

Bell's original description was as follows:

> This species appears to stand next to *A.* [*Adelometra*] *angustriadia* of Carpenter's classification, for there are three distichals [IIBr series] not succeeded by palmars [IIIBr series], and the cirri are of great length, but not in as many as ten vertical rows, nor is the distichal pinnule [$\mathrm{P_D}$] larger than the rest.
>
> The centrodorsal is high, with three or four vertical rows of sockets, the cirri may be as much as 70 mm. long, and the joints 60–80 in number; the most proximal one very short, the next much longer, their successors broad and flattened from side to side, the distal 40 are keeled. The proximal arm joints are fairly rectangular, the rest are narrower, alternately, on one side than the other; no pinnules are very long, but they are all stout.
>
> Length of arm about 100 mm. Colour, cream yellow.

In the British Museum I examined 6 specimens under Nos. 12885/6 and 1 under No. 12792. The cirri are XV–XXV, 60–63; the eighth or ninth is a transition segment. The cirrus sockets are arranged in 10 columns, the two columns in each radial area being separated from each other by a midradial furrow.

A specimen from 20 miles NW. 1/2 N. of East London, according to Gislén, is small; the centrodorsal is dorsally spinous; there are 39 cirrus segments; the elements of the IBr series have an indistinct longitudinal crest but are otherwise smooth; the 10 arms are about 75 mm. long. Another specimen from the same locality is larger; there are 50 cirrus segments; the margins of the elements of the IBr series are everted, the eversions being finely denticulate; there are 16 arms; following a IIBr axillary syzygies occur between brachials 1+2 and 3+4.

In a specimen from 7.5 miles NW. by N. of the Umhlangakulu River the one cirrus remaining is 70 mm. long with 63 segments; the 20 arms are 80 mm. long.

In a specimen from Union of South Africa stations 3719–20 the cirri are about 55 mm. long with about 50 segments. In an example from Union of South Africa station 4068 the cirrus sockets are arranged in 10 columns of the centrodorsal; the cirri are 65 mm. long with about 60 segments; the 20 arms are 110+ mm. long.

In a specimen from Union of South Africa station 6244 four of the IIBr series are 2 and six are 4(3+4). In another specimen from the same station the IIBr series are probably all 4(3+4).

Localities.—*Pieter Faure;* Buffalo River, East London, bearing N. 15 miles distant; 567 meters; coral and mud (12885/6) [Bell, 1905; A. H. Clark, 1908, 1909, 1911, 1912, 1913, 1915, 1918; H. L. Clark, 1923; Gislén, 1928] (6, B. M.).

Pieter Faure; Buffalo River, East London, bearing N. W. ½ W. 19 miles distant; 548 meters; sand and broken shells (12725) [Bell, 1905; A. H. Clark, 1908, 1909, 1911, 1912, 1913, 1915, 1918; H. L. Clark, 1923; Gislén, 1928].

Pieter Faure; East London bearing N. W. ½ N., approximately 20 miles distant; 731–823 meters; sand and stones (12792 or 12792A) [Bell, 1905; A. H. Clark, 1908, 1909, 1911, 1912, 1913, 1915, 1918; H. L. Clark, 1923; Gislén, 1928] (1, B. M.).

Pieter Faure; 7.5 miles N. W. by N. of Umhlangakulu River, southern Natal; 91 meters; sand, gravel, and sponge fragments (12831) [Gislén, 1938].

Union of South Africa stations 3719–20; east of Durban (Port Natal), Natal (lat. 29°51′ S., long. 31°28′ E.) [Gislén, 1938].

Union of South Africa station 4068 [Gislén, 1938].

Union of South Africa station 6244; northeast of Durban, Natal (lat. 29°34′ S., long. 31°32′ E.) [Gislén, 1938].

Geographical range.—Southeastern Africa from the vicinity of Port Elizabeth northeastward along the coast to Durban (Port Natal), Natal.

Bathymetrical range.—From 91 to 731 (?823) meters; the average of four records is 552 meters.

History.—This species was described as *Antedon magnicirra* in 1905 by Prof. Francis Jeffrey Bell from an unspecified number of specimens dredged off East London in 300–450 fathoms (Nos. 12725, 12792, 12885, and 12886). He said that it "appears to stand next to *A.* [*Adelometra*] *angustiradia* of Carpenter's classification"—that is, to be a member of Carpenter's *Savignyi* group all the species in which belong to the genera *Craspedometra* and *Heterometra*. In 1908 I published a note assigning *magnicirra* to the genus *Thalassometra,* and remarked that it belongs to the *Granulifera* group of Carpenter.

In two papers published in 1908 I listed *Thalassometra magnicirra* as a characteristic oceanic species. In a revision of the family Thalassometridae published in January 1909 I listed *Antedon magnicirra* among the species I was unable to place satisfactorily.

When I established *Crotalometra* later in 1909 I said that *Antedon magnicirra* is a member of this genus, and in other papers published in the same year I compared *Crotalometra magnicirra* with the new species *C. rustica* and *C. sentifera.* In a paper on Recent African crinoids published in 1911 *Crotalometra magnicirra* was listed, and the synonymy and range were given.

In my description of *Thalassometra marginalis* published in 1912 I said that it is closely related to *Th. magnicirra*, and in my memoir on the crinoids of the Indian Ocean published later in the same year I listed *Thalassometra magnicirra*, giving the synonymy and range.

In a paper on the crinoids of the British Museum published in 1913 I listed six specimens of *Crotalometra magnicirra* from stations Nos. 12885/6 and gave notes on them; I also listed one specimen from station 12792. In my memoir on Antarctic crinoids published in 1915 I noted that "*Crotalometra magnicirra* (Thalassometridae) wurde bei East London, Kapland, in 540–810 m. (300–450 Faden) gefunden." In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *magnicirra* was inserted in the key to the species of *Crotalometra* and the range and synonymy were given.

Dr. Hubert Lyman Clark in his memoir on the echinoderms of South Africa published in 1923 said that *Crotalometra magnicirra* "is not now in the South African Museum, the original specimens having apparently all been retained at the British Museum. It was taken in 300–450 fathoms, 15–20 miles off the coast of Cape Colony, near East London."

After examining the specimens in the British Museum, Prof. Torsten Gislén wrote in 1928 that in *Crotalometra magnicirra* the radials are concealed, the interradial prominences of the centrodorsal are rather stout and large, and there are usually 20 arms. He suggested that *C. marginalis* is probably a large specimen of *C. magnicirra*.

In my report upon the crinoids of the John Murray Expedition to the Indian Ocean in 1933–34, published on January 1, 1937, I gave the range of *Crotalometra magnicirra* and discussed its zoogeographical significance.

KOEHLERMETRA, gen. nov.

Antedon (part) P. H. Carpenter, Philos. Trans. Roy. Soc., vol. 174, 1883, 1884, p. 921, and following authors.

Actinometra (part) P. H. Carpenter, *Challenger* Reports, Zool., vol. 26, pt. 60, 1888, pp. 305, 306.

Thalassometra (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126.

Antedon (*Crotalometra*) Koehler and Vaney, Bull. Mus. Hist. Nat. Paris, 1910, No. 1, p. 26.

Crotalometra (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, pp. 8, 37.

Diagnosis.—A genus of Thalassometridae in which the arms are dorsally rounded to the tip; the arms in fully developed individuals are 20 in number with the IIBr series 4(3+4), exceptionally 2; the division series and arm bases are smooth and without spines; the first syzygy in arms following a IIBr 4(3+4) series is between brachials 2+3; the cirri, which are very stout, are recurved distally with the outer segments carinate or with dorsal spines; and the genital pinnules are not appreciably expanded. The included species are large and very stout with the 20 arms about 150 mm. long, and the cirri up to 55 mm. long with 30–50 segments.

Genotype.—*Antedon porrecta* P. H. Carpenter, 1888.

Geographical range.—From Ascension Island to the northern part of the Bay of Biscay.

Bathymetrical range.—From 753 to 1,410 meters.

Remarks.—The species of the genus *Koehlermetra* are very robust, indeed the most robust of all the species of Thalassometridae. In this respect they are parallel to the species of *Crinometra* and *Crossometra* in the family Charitometridae, in which family *Pachylometra* in a general way corresponds to *Crotalometra*.

The two species of *Koehlermetra* seem not to differ except in the number of cirrus segments, and Hartlaub has suggested that they may represent varieties of the same specific type. I have examined all the known specimens of both species, but unfortunately did not have time to study them in detail.

KEY TO THE SPECIES IN THE GENUS KOEHLERMETRA

a^1. Cirri with 40–50 segments, 55 mm. long; 20+ arms 150 mm. long (Ascension Island to the Bay of Biscay; 768–1,420 meters)..porrecta (p. 101)

a^2. Cirri with about 30 segments; 20 arms (northern part of the Bay of Biscay to the Canary Islands; 753–1,410 meters)..flava (p. 105)

KOEHLERMETRA PORRECTA (P. H. Carpenter)

[See vol. 1, pt. 2, pl. 34, figs. 1207–1209.]

Comatule Parfait, Rapport sur la campagne scientifique du *Talisman* en 1883, 1884, p. 57 (45°59′ N., 6°29′ W.; 1,480 meters).—Filhol, La Nature, vol. 12, 1884, p. 329 (the figure of a multibrachiate comatulid from off Rochefort, 1,500 meters); La vie au fond des mers, 1885, plate between pp. 10–11 (same).—de Folin, Sous les mers, 1887, p. 335 (Gulf of Gascony, 1,480 meters).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 48.

Antedon sp. P. H. Carpenter, Philos. Trans. Roy. Soc., vol. 174, 1883, 1884, p. 921 (pentacrinoid from near Ascension [*Challenger* station 344]; characters; comparison with *Thaumatocrinus*), pl. 71, fig. 6; Bijdr. Dierk., Afl. 14, 1887, p. 48 (3 pentacrinoids from Ascension; comparison with the *Varna* pentacrinoids).

Antedon porrecta P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 250 (description; *Challenger* station 344), pl. 52, figs. 3–5; Journ. Linn. Soc. (Zool.), vol. 24, 1891, p. 66 (comparison with [*Stiremetra*] *lusitanica*).—Koehler, Rev. Biol. Nord France, vol. 7, 1895, p. 475 (compared with *Antedon flava*, sp. nov.); Ann. Univ. Lyon, vol. 26, Resultats scientifique de la campagne du *Caudan*, June 1896, p. 97 (compared with *flava*).—Hamann, Bronn's Klassen und Ordungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1582 (listed).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (belongs to the genus *Thalassometra*); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 225 (referred to *Thalassometra*); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 18 (not placed in the revision of the Thalassometridae).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 285 (in the *Granulifera* group; doubtless different from *granulifera*), p. 286 (referred by Clark to the Thalassometrinae).—Mortensen, Handbook of the echinoderms of the British Isles, 1927, p. 25.

Antedon multispina (part) P. H. Carpenter, *Challenger* Reports, Zool., vol. 26, pt. 60, 1888, p. 118, last paragraph (3 pentacrinoids from station 344), pl. 14, figs. 5–7.—Kirk, Proc. U. S. Nat. Mus., vol. 41, 1911, p. 75, footnote (quoting [incorrectly] A. H. Clark), pl. 7, figs. 8–10 (from Carpenter).

Actinometra pulchella (part) P. H. Carpenter, *Challenger* Reports, Zool., vol. 26, part 60, 1888, pp. 305, 306 (*Talisman* record; off Rochefort, 1,500 meters; reference to Filhol's figure).

Actinometra, sp. W. Marshall, Die Tiefsee u. ihr Leben, 1888, pl. 4; figure of a multibrachiate comatulid (from Filhol, with identification by Carpenter).

Thalassometra porrecta A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (*Antedon porrecta* should be assigned to *Thalassometra*); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 225 (same); Amer. Nat., vol. 42, 1908, No. 500, p. 542 (characteristic oceanic species); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (same).

Antedon (*Crotalometra*) *porrecta* Koehler and Vaney, Bull. Mus. Hist. Nat. Paris, 1910, No. 1, p. 26 (collected by the *Travailleur* or the *Talisman*), p. 32 (45°19′ N., 6°29′ W.; 1,480 meters).

Crotalometra porrecta A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 8 (west coast of Africa), p. 37 (near Ascension, 420 fathoms; also Bay of Biscay, 1,480 meters); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 46 (published references to specimens in the B. M.; *Challenger* Sta. 344; characters of the cirri); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 148 (in key; range), p. 149 (references); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range); GISLÉN, Zool. Bidrag Uppsala, vol. 9, 1924, p. 28, footnote.—MORTENSEN, Handbook of the echinoderms of the British Isles, 1927, p. 25 (localities; in key).—GISLÉN, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 7, No. 30 (notes); Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 23.

Thalassometra multispina (part) A. H. CLARK, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 47 (the pentacrinoid from *Challenger* station 344).

Crotalometra porrecta GISLÉN, Zool. Bidrag Uppsala, vol. 9, 1924, p. 194 (supposed larva).

Diagnostic features.—The cirri have 40–50 segments and are 55 mm. long; the 20+ arms are 150 mm. long.

Description.—The centrodorsal is a thick disk with the interradial angles slightly produced.

The cirri are XX–XXX, 40–50, long and stout (according to the figure about 55 mm. long). The longest proximal segments are about as long as broad, but most of the segments are broader than long and are produced on the dorsal side into a strong pointed process which at first involves only the distal portion but later rises from most of the dorsal surface.

The radials are invisible except in the interradial angles of the calyx. The elements of the IBr series are rather convex and are slightly tubercular at the articulation between them. The IBr_1 are short, laterally united, and the IBr_2 (axillaries) are broadly pentagonal, about two and one-half times as long as the IBr_1. The IIBr series are 4(3+4) and the IIIBr series, when present, are 3(2+3). The elements of the division series are very convex and have their sides flattened against each other, but this is less marked on the outside of the postradial series where the hypozygals of the IIBr and IIIBr axillaries and the second brachials are kept apart by the large pinnule on the segment preceding.

There are 20+ arms, probably 150 mm. long. They are composed of compressed triangular brachials which become elongated and quadrate distally. From the fourteenth brachial onward the middle of the distal edge of each ossicle is raised into a strong plate the front face of which is hollowed. Beyond the eleventh or sixteenth brachial this gives place to an overlap of the usual character that extends far out on the arm.

Syzygies occur between brachials 2+3, again from between brachials 7+8 to between brachials 15+16, and distally at intervals of from 4 to 13 muscular articulations, the intervals becoming shorter toward the end of the arms.

P_1 and the preceding pinnules on the $IIBr_2$ and $IIIBr_1$ are tolerably equal with about 15 stout segments the five lowest of which are rather broad and trihedral with flattened outer faces and the inner sides slightly beveled away. P_a and P_2 are smaller with fewer segments of which the basal are more compressed. The pinnules following are larger again with broader lower segments the outer edge of which is expanded toward the ventral side. This feature gradually dies away in the outer parts of the arms, and the segments become more elongated.

The disk is 15 mm. in diameter, slightly incised and well plated like the brachial ambulacra. The pinnule ambulacra have well defined side plates and small sacculi.

The color in alcohol is dark gray-brown.

Notes.—The preceding description is adapted from the original description by Carpenter, with a few additions from his figures. At the British Museum in 1910 I examined one large and two small specimens from the type material. In the larger specimen the cirri are XIV, from 50 to 54 mm. long; the eighth or ninth is a transition segment. I noted that this species is remarkable for the great size and stoutness of its cirri.

These specimens were later examined by Prof. Torsten Gislén, who suggested that perhaps there were muscles in the most proximal syzygies.

Localities.—*Challenger* station 344; south Atlantic, near Ascension Island (lat. 7°54′20″ S., long. 14°28′20″ W.); 768 meters; volcanic sand; April 3, 1876 [P. H. Carpenter, 1884, 1887, 1888, 1891; Koehler, 1896; A. H. Clark, 1908, 1909, 1911, 1913, 1918, 1923; Kirk, 1911; Hartlaub, 1912; Gislén, 1924, 1928, 1934; Mortensen, 1927] (3, B. M.).

Talisman; Bay of Biscay; west of Rochefort (lat. 45°19′ N., long. 6°29′ W.); 1,420 meters; August 30, 1883 [Parfait, 1884; Filhol, 1884; de Folin, 1887; Marshall, 1888; A. H. Clark, 1911, 1918, 1923; Koehler and Vaney, 1910; Mortensen, 1927].

Geographical range.—Eastern Atlantic from the vicinity of Ascension Island northward to the Bay of Biscay

Bathymetrical range.—From 768 to 1,420 meters.

History.—In his account of the scientific investigations of the French steamer *Talisman* in 1883, published in 1884, Capt. Jacques Théophile Parfait, the commanding officer, mentioned a comatulid from lat. 45°59′ N., long. 6°29′ W., in 1,480 meters. Henri Filhol in 1884 published a figure of a multibrachiate comatulid from off Rochefort in 1,500 meters, republishing the same figure in 1885. The Marquis de Folin in 1887 referred to a comatulid from the Gulf of Gascony in 1,480 meters.

Dr. Philip Herbert Carpenter in 1884 described and figured a pentacrinoid larva that had been dredged by the *Challenger* in lat. 7°54′20″ S., long. 14°28′20″ W. in 420 fathoms which he identified as the young of *Antedon* (*Thalassometra*) *multispina*, but which almost certainly is the young of this species (see Part 2, p. 521). In 1887 he compared this with some pentacrinoids from the *Varna* expedition which are the young of *Heliometra glacialis*.

In the *Challenger* report on the comatulids published in 1888 Carpenter described *Antedon porrecta* in detail and figured it. The three pentacrinoids from station 344 he described and figured under *Antedon* (*Thalassometra*) *multispina*, and Filhol's figure of a multibrachiate comatulid from off Rochefort he identified as *Actinometra pulchella* (=*Neocomatella europaea*; see Part 3, p. 153). He noted that the length of the cirri and the strong dorsal processes on their numerous segments are good distinctive characters, and that one cirrus has been broken and subsequently regenerated. He said that the characters of the pinnules of *porrecta* are the same as those of *Antedon* (*Charitometra*) *basicurva* and its allies, though in a less marked degree. The lower segments of the genital pinnules are expanded toward the ventral side so as to protect the genital glands, which have but a slight covering of anambulacral plates, while the first two pinnules have massive lower segments with the outer side flattened just as in *Antedon* (*Aglaometra*) *valida* and *incerta*.

In 1888 Dr. William Adolf Ludwig Marshall republished Filhol's figure which he identified as *Actinometra* sp., following Carpenter. In 1891 Carpenter compared *porrecta* with *Antedon* (*Stiremetra*) *lusitanica*, and in 1895 and 1896 Prof. René Koehler compared it with his new species *Antedon* (*Crotalometra*) *flava*.

In a paper published on April 11, 1908, I assigned *porrecta* to my new genus *Thalassometra* described in the preceding year, repeating this in a paper published on May 14. In two other papers published in the same year *Thalassometra porrecta* was listed as a characteristic species of the oceanic fauna. In a revision of the family Thalassometridae published in 1909 I included *Antedon porrecta* among the species I was unable to allocate satisfactorily.

In 1910 Profs. René Koehler and Clement Vaney recorded *Antedon* (*Crotalometra*) *porrecta* from a *Travailleur* or *Talisman* station in lat. 45°19′ N., long. 6°29′ W. in 1,480 meters, August 30, 1883. The only comatulid dredged at this station was one specimen of this species; with this there were 10 specimens and numerous fragments of *Annacrinus wyville-thomsoni*. *Crotalometra porrecta*, therefore, was the "comatule" mentioned by Captain Parfait and the Marquis de Folin, and figured by Filhol and Marshall. Captain Parfait gave the latitude as 45°59′ N.; as Filhol gave the locality as off Rochefort this is probably correct.

In a paper on the crinoids of the coasts of Africa published in 1911 I included *Crotalometra porrecta* and gave the synonymy and range.

Speaking of the pentracrinoids from *Challenger* station 344 Dr. Edwin Kirk wrote:

> Mr. A. H. Clark says that these three specimens identified by Carpenter as *A. multispina* do not appear to belong to the same species and, indeed, may be referable to different groups. Furthermore he states that the figures are inaccurate. It scarcely seems probable that the draftsman could go far wrong in regard to the columnals, however, and the evidence of fusion having taken place, though by no means conclusive, still seems fairly good.

I told Dr. Kirk that these pentracrinoids appear to belong not to *multispina* but to *porrecta*, in a different generic group. I did not say that the figures were inaccurate but that it was inaccurate to interpret them as indicating that the centrodorsal is composed of more than a single ossicle.

In his memoir on the comatulids of the *Blake* expedition published in 1912 Dr. Clemens Hartlaub discussed this species in relation to the other species in Carpenter's *Granulifera* group. He said he had the impression that Carpenter here, as elsewhere, had made too many species, and he suggested that *Antedon angusticalyx*, *A. inaequalis*, and *A. distincta* were really synonymous with Pourtalès' *A. granulifera*, though the doubtless different *A. porrecta* and *A. multispina* should be retained. He regarded Koehler's *Antedon flava* as probably a synonym of *porrecta*.

In a paper on the crinoids of the British Museum published in 1913 I noted that I had examined one large and two small specimens of *Crotalometra porrecta* from *Challenger* station 344 and gave notes on them. In my report on the unstalked crinoids of the *Siboga* expedition published in 1918 *porrecta* was included in the key to the species of *Crotalometra*, and the synonymy and range were given. This information was repeated in my report on the crinoids of the *Ingolf* expedition published in 1923.

Prof. Torsten Gislén in 1924 discussed certain points in the structure and developmental stages of the three pentacrinoids from *Challenger* station 344, which he identified as the young of *Crotalometra porrecta* with a query.

In his handbook of the echinoderms of the British Isles published in 1927 Dr. Theodor Mortensen inserted *porrecta* in his key to the east Atlantic species of *Crotalo-*

metra and gave the range of the species. Professor Gislén, after examining the specimens of this species in the British Museum, suggested in 1928 that perhaps the proximal syzygies contain muscles, and in 1934 he discussed the brachial structure at length.

KOEHLERMETRA FLAVA (Koehler)

[See vol. 1, pt. 2, figs. 210, p. 150, 531, 532, p. 287.]

Antedon flava Koehler, Rev. biol. nord France, vol. 7, 1895, p. 475 (description; *Caudan* station 4); Ann. Univ. Lyon, Resultats scientifique de la campagne du *Caudan*, June 1896, pp. 27, 97 (detailed description; station 4), pl. 2, figs. 20, 21.—Grieg, Bergens Mus. Aarbog for 1903, No. 5, 1904, p. 35.—A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (belongs to the genus *Thalassometra*); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 225 (referred to *Thalassometra*); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 18 (not placed in the revision of the Thalassometridae).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 285 (belongs to the *Granulifera* group), p. 285, footnote (close relationship with *porrecta*).—W. de Morgan, Journ. Mar. Biol. Assoc., new ser., vol. 9, No. 4, March 1913, pp. 539, 540 (*Huxley* station 13).—Mortensen, Handbook of the echinoderms of the British Isles, 1927, p. 25.

Thalassometra flava A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (should be assigned to *Thalassometra*); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 225 (same); Amer. Nat., vol. 42, No. 500, 1908, p. 542 (characteristic oceanic species); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (same).

Antedon (*Crotalometra*) *flava* Koehler and Vaney, Bull. Mus. Hist. Nat. Paris, 1910, No. 1, p. 26 (collected by the *Travailleur* or the *Talisman*), p. 31 (locality).

Crotalometra flava A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 7 (northwestern coast of Africa), p. 37 (synonymy; south of the Canary Islands, 882 meters; also Bay of Biscay, 1,480 [error for 1,410] meters); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 148 (in key; range), p. 149 (references); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range).—Mortensen, Handbook of the echinoderms of the British Isles, 1927, p. 25 (localities; in key).—Koehler, Echinodèrmes des mers d'Europe, vol. 2, 1927, p. 133 (habitat).

Diagnostic features.—The cirri have about 30 segments.

Description.—The centrodorsal is flattened. In one of the specimens it is very large, its diameter reaching 6 mm. In the other it is much smaller with a diameter of only 3 mm.

The cirri in the latter are XXII, in the former XXVI, with many broken off at the base. They have about 30 segments of which the length increases progressively from the first to the sixth, which is the longest, twice as long as broad; after the tenth the segments become a little broader than long. On the sixth the distal border on the dorsal side begins to rise and forms a point that becomes more marked on the segments following and is continued to the end of the cirri.

The radials are completely concealed. The IBr_1 are partially concealed and are in close contact laterally. The IBr_2 (axillaries) are entirely free laterally. The IIBr series are 4(3+4). The first two elements of the IIBr series rise on the dorsal side into a well marked blunt tuberosity.

The 20 very stout arms are flattened laterally. At the proximal angle the lower border of each brachial is produced into a broad process which accompanies the corresponding pinnule.

Syzygies occur between brachials 2+3, again from between brachials 19+20 to between brachials 21+22, and distally at intervals of from 7 to 13 muscular articulations.

P_D and P_1 are flattened and prismatic and are composed of 16 or 17 segments of which the proximal are very broad. The two following pinnules are smaller and shorter, and the number of their segments does not exceed 10. The succeeding pinnules are larger and have 15 segments; their length is almost equal to that of P_D and P_1.

In the living animal the cirri and arm bases are bright saffron yellow which becomes deeper and passes into light brown on the outer half of the arms. Koehler said that this coloration is in part preserved in alcohol.

Notes.—Dr. Clemens Hartlaub wrote that *Antedon flava* by virtue of the position of the first brachial syzygy between brachials 2+3 is in the closest agreement with *A. porrecta* which alone among the species of the *Granulifera* group possesses this feature. He said that the chief difference between *flava* and *porrecta*—the length of the cirri—did not seem so important to him as it had to Koehler. The cirri of *flava* are much shorter than those of *porrecta,* about 35–38 mm. long. According to Carpenter's figure the longest cirrus of *porrecta* is somewhat less than 55 mm. long and another is barely 45 mm. long. The number of cirri in the two species does not differ—in *porrecta* XX–XXX, in *flava* XXV–XXVI. The number of cirrus segments is less in *flava* (about 30) than in *porrecta* (40–50). The form of the outer cirrus segments according to the figures is the same in both. The centrodorsals of the two species appear to show no noteworthy differences. A "tuberosité mousse assez marquée" on the first two elements of the IIBr series that Koehler describes in *flava* appears, according to Carpenter's figure, to be lacking in *porrecta.* There are some differences in the position of the second and following syzygies. The number of segments in P_D is the same in each (16–17 and about 15). In the form of the lower segments of P_D there is apparently close correspondence. This appears to be the case also in the relationship of the following pinnules. In view of the great variability of the species of *Antedon* (in the old sense) it seemed to Hartlaub that the slight differences between *porrecta* and *flava* are scarcely sufficient to justify the establishment of a new species.

Localities.—Huxley station 13; off Brittany (lat. 48°07′30″ N., long. 8°13′00″ W.); 753 meters; sand, mud, and hard ground; August 1906 [de Morgan, 1913; A. H. Clark, 1918, 1923; Mortensen, 1927; Koehler, 1927].

Caudan station 4; Bay of Biscay, west of La Rochelle (lat. 45°57′ N., long. 6°21′ W.); 1,410 meters; coral and mud; August 21, 1895 [Koehler, 1895, 1896, 1927; Grieg, 1904; A. H. Clark, 1908, 1909, 1911, 1918, 1923; Hartlaub, 1912; de Morgan, 1913; Mortensen, 1927] (1, U.S.N.M., 35583).

Talisman; south of the Canary Islands (lat. 25°39′ N., long. 18°22′ W.); 882 meters; July 9, 1883 [Koehler and Vaney, 1910; A. H. Clark, 1911].

Geographical range.—From the northern part of the Bay of Biscay south to the Canary Islands.

Bathymetrical range.—From 753 to 1,410 meters.

History.—Prof. René Koehler described *Antedon flava* in 1895 from two specimens dredged by the French steamer *Caudan* at station 4 in August of the same year. He said that *A. flava* belongs to the *Granulifera* group; like *A. porrecta* it has a syzygy in the second brachial (that is, the first syzygy is between brachials 2+3), but is distinguished at a glance by the cirri, which are much shorter. In 1896 he gave a brief but interesting account of the dredge haul at which the specimens were captured, which was very near the spot where the *Talisman* had found *Annacrinus wyville-thomsoni* in great abundance. He said that *A. flava* is remarkable for its superb sulphur yellow color, which unfortunately fades strongly in alcohol. He republished the original description, adding nothing new, and figured a cirrus and a portion of an arm with four pinnules.

In a discussion of the adambulacral plates and other details of the pinnules of north Atlantic comatulids published in 1904 Dr. James A. Grieg mentioned that he had had no opportunity to examine the pinnules of *Antedon flava*, but presumably they are quite different from those of the other species since it belongs to the *Granulifera* group.

In a paper published on April 11, 1908, and in another published on May 14, I assigned *Antedon flava* to the genus *Thalassometra*, and in two papers published later in the same year *Thalassometra flava* was given as a characteristic oceanic species. In my review of the family Thalassometridae published in 1909 *Antedon flava* was listed among the species I was unable to place satisfactorily.

In 1910 Profs. René Koehler and Clement Vaney recorded without comment two specimens of *Antedon* (*Crotalometra*) *flava* from lat. 25°39′ N., long. 18°22′ W., in 882 meters, that had been dredged by the French steamer *Talisman*. In my paper on the crinoids of the coasts of Africa published in 1911 I listed *Crotalometra flava*, giving the synonymy, the African locality, and the range.

In his memoir on the comatulids of the *Blake* expedition published in 1912 Dr. Clemens Hartlaub compared this species in detail with *C. porrecta*, coming to the conclusion that the differences between them scarcely sufficed for the establishment of a new species.

In 1913 Dr. W. de Morgan recorded *Antedon flava* from *Huxley* station 13, his specimens having been identified by Professor Koehler.

In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 I included *flava* in my key to the species of the genus *Crotalometra* and gave the synonymy and range, and in my memoir on the crinoids of the *Ingolf* expedition *Crotalometra flava* was listed, with the range.

In 1927 Professor Koehler included an account of *Crotalometra flava* in his memoir on the echinoderms of the European seas, and Dr. Theodor Mortensen mentioned it, with its range, in his handbook of the echinoderms of the British Isles.

Genus AGLAOMETRA A. H. Clark

Antedon (part) P. H. Carpenter, *Challenger* Reports, Zool., vol. 11, pt. 32, 1884, p. 57, and following authors.

Thalassometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360.

Crotalometra (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 404.

Aglaometra A. H. Clark, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 47 (no diagnosis, and no type mentioned; 2 species cited under this generic name, *Aglaometra valida* and *A. incerta*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 146 (in key; range), p. 163 (key to the included species).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 7; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.

Diagnosis.—A genus of Thalassometridae in which the arms are dorsally rounded to the tips; the arms are 10 in number; the IBr series and arm bases are rounded dorsally, not carinate, smooth or almost so, without numerous and conspicuous spines; the cirri are recurved distally, the short outer segments carinate or bearing spines dorsally; there is no appreciable expansion of the genital pinnules; and the size is large, the arms being 90–150 mm. long and the cirri 45–90 mm. long with 59–70 segments.

Geographical range.—From the northern Philippines to the Moluccas and the Kermadec Islands, north of New Zealand.

Bathymetrical range.—From 457 to 1,165 (?1,264) meters.

Thermal range.—From 4.17° to 10.2° C.

Remarks.—There appear to be four readily recognizable species in this genus. Of the six species heretofore recognized, *valida, eupedata, incerta, propinqua, vera,* and *sulcata,* two are considered synonyms herein, *eupedata* a synonym of *valida* and *vera* a synonym of *propinqua.*

The genus *Aglaometra* appears not to differ appreciably from *Stiremetra* except in the greater size of the included species, which have the IBr series and lower brachials more broadly rounded dorsally.

History.—The first known species of this genus were described as *Antedon valida* and *A. incerta* by Dr. P. H. Carpenter in his report on the comatulids of the *Challenger* expedition published in 1888. These species were transferred to my new genus *Thalassometra* upon its establishment in 1907. In my revision of the family Thalassometridae published on January 9, 1909, *Antedon incerta* and *A. valida* were included in the list of species I was unable to place satisfactorily. On May 13, 1909, I established the new genus *Crotalometra* with the genotype *C. eupedata,* sp. nov., and referred *Antedon valida* and *A. incerta* to it, together with Bell's *Antedon magnicirra.* The generic name *Crotalometra* had, however, appeared previously in the description of a new species, *C. rustica,* which thereby became the genotype (see page 92). In 1911 I described *Crotalometra propinqua,* and in 1912 *C. sulcata* and *C. vera.* In my memoir on the crinoids of the Indian Ocean published later in 1912 *Crotalometra eupedata, C. propinqua, C. valida,* and *C. incerta* were listed and their synonymies and ranges were given. In a paper on the crinoids of the British Muesum published in 1913, under the heading, "Genus *Aglaometra* A. H. Clark," I gave notes on Carpenter's specimens of *A. valida* and *A. incerta.* Of these two, *A. valida* should be taken as the genotype. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *Aglaometra* was included in the key to the genera of the subfamily Thalassometrinae, and *Aglaometra eupedata, A. sulcata, A. valida, A. vera, A. propinqua,* and *A. incerta* were listed.

KEY TO THE SPECIES IN THE GENUS AGLAOMETRA

a^1. Ossicles of the division series and lower brachials everywhere in close lateral contact.

b^1. Cirri long and stout, more than half the arm length.

c^1. Large and stout; proximal portion of the animal strongly compressed, the lateral profiles from the base of the centrodorsal nearly straight, the two sides making with each other an angle of approximately 45° when the division series are all in contact; arms 100–150 mm. long, cirri 80–90 mm. long with 65–66 segments (from Mindanao to Celebes; 457–1,165 [?1,264] meters)------------**valida** (p. 109)

c^2. Somewhat smaller and less stout; proximal portion of the animal broadly rounded, the profiles of the axillaries making with each other an angle of about 90°, but the arms being nearly parallel; arms 90 mm. long, cirri 50 mm. long with 70 segments (Kermadec Islands; 1,152 meters)------------**incerta** (p. 114)

b^2. Cirri shorter and more slender, less than half the arm length; arms 130 mm. long, cirri 45–60 mm. long with 59–69 segments (Philippines and Moluccas; 567–960 meters)-**propinqua** (p. 116)

a^2. Distal angles of the IBr$_1$ and proximal angles of the axillaries and the corresponding angles of the first two brachials and of the elements of the first syzygial pair widely cut away, forming large and prominent rhombic water pores; the edges of the ossicles bordering these water pores are more or less everted and coarsely denticulate, or bear a few coarse spines; arms about 115 mm.

long, cirri 60–65 mm. long with 63–64 segments (west of Waigeu to northern Celebes; 457–798 meters)............sulcata (p. 118)

AGLAOMETRA VALIDA (P. H. Carpenter)

PLATE 12, FIGURE 37; PLATE 13, FIGURES 38, 39

[See also vol. 1, pt. 2, fig. 225, p. 179.]

Antedon valida P. H. CARPENTER, *Challenger* Reports, Zool., vol. 26, pt. 60, 1888, p. 104 (description; station 214), pl. 15, figs. 5–8.—HARTLAUB, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (systematic and bathymetrical relationships), p. 134 (size compared with that of [*Thalassometra*] *agassizii*).—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 18 (not placed in a revision of the Thalassometridae); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 404 (referred to *Crotalometra*); Crinoids of the Indian Ocean, 1912, p. 33 (of P. H. Carpenter, 1888=*Crotalometra valida*).

Thalassometra valida A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3. 1907, p. 360 (listed).

Crotalometra eupedata A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 404 (description; *Albatross* station 5236; also station 5116); Proc. U. S. Nat. Mus., vol. 39, 1911, pp. 549, 550 (cirri compared with those of *C. propinqua*), p. 551 (small 11-armed specimen doubtfully referred to this species in 1909 is really [*Oceanometra*] *annandalei*); Crinoids of the Indian Ocean, 1912, p. 209 (synonymy; locality).

Crotalometra valida A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 33 (=*Antedon valida* P. H. Carpenter, 1888), p. 209 (synonymy; locality).

Aglaometra valida A. H. CLARK, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 47 (published references to specimens in the B. M.; *Challenger* station 214; comparison with *A. eupedata*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 163 (in key; range), p. 164 (notes; station 122), p. 273 (listed).

Aglaometra eupedata A. H. CLARK, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 47 (comparison with *valida*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 163 (in key; range), p. 164 (references).

Diagnostic features.—The elements of the IBr series and lower brachials are in close lateral contact; the proximal portion of the animal is strongly compressed, the lateral profiles from the base of the centrodorsal being nearly straight and making with each other an angle of approximately 45° when the division series and arm bases are in contact; and the cirri are long and stout, much more than half the length of the arms. The 10 arms are 100–150 mm. long, and the cirri are 80–90 mm. long with 65–66 segments.

Description.—The centrodorsal is large and conical, with the ventral interradial angles produced. The cirrus sockets are arranged in 10 columns, one or two to a column. The columns are situated along the outer borders of the radial areas and are separated in the midradial line by a bare and somewhat excavated triangle which at the base, just below the radials, is as broad as, or broader than, the adjacent cirrus sockets.

The cirri are about XV, about 65, up to 80 mm. in length; the seventh–twelfth segments are considerably longer than broad, but from the twenty-fifth onward the segments are short and broad with a strong dorsal spine.

The radials are just visible. The elements of the IBr series are strongly convex in the middle of the articulation between them. The borders of the radials, the elements of the IBr series, and the lowest brachials are fringed with strong spines. The IBr_2 (axillaries) and first brachials have straight edges and flattened sides.

The 10 arms are probably about 100 mm. long. The brachials are triangular, slightly overlapping, the later somewhat compressed laterally. The second brachials and the hypozygals of the first syzygial pairs are flattened on the inner side only. The line of junction between the first two brachials is somwehat tubercular.

Syzygies occur between brachials 3+4, again at about the thirteenth brachial, and distally at intervals of from 5 to 16 muscular articulations.

P_1 is large and stout; the first eight segments have broad and flattened outer sides, and the third, fourth, and fifth have the inner edges bent upward and somewhat thickened, but in the next following these are sharpened and form a keel. P_a is similar but smaller, with the outer side flattened. The pinnules of the next two pairs have broad and carinate lower segments, and the later pinnules are more styliform with the two basal segments expanded and trapezoidal and those following elongated.

The disk is 11 mm. in diameter, thickly covered with plates which extend out onto the arms at the sides of the ambulacra, and also over the gonads. The pinnule ambulacra have well-defined side- and covering-plates. Sacculi are very rare.

Notes.—The preceding description is adapted from that of Carpenter, with a few additions from his figures. In 1910 I examined two of Carpenter's specimens in the British Museum. This is a large species, resembling in a general way *A. eupedata;* the distal edges of the radials and the lateral edges of the IBr series and first two brachials are conspicuously dentate with fine well separated teeth.

In the specimens from *Siboga* station 122 the dorsal pole of the centrodorsal is more blunted than in Carpenter's specimens, and is studded with numerous small low tubercles. The cirrus sockets are in 10 columns which are interradially in apposition, though well separated in the midradial line. There is usually only a single functional cirrus socket to a column. The more distal obsolete cirrus sockets develop conical tubercles of which the axes are parallel to the dorsoventral axis of the animal. These tubercles are proportionate in size to the size of the cirrus socket they occupy; thus below the functional socket in the columns there is in each radial area a double row of tubercles of diminishing size which continues to the dorsal pole, there merging with the small polar tubercles.

There are three cirri remaining which are composed of 45 (one) and 61 (two) segments; in the first the transition segment is the ninth, in the two others the eighth. the cirri decrease slightly in diameter to the transition segment, and in lateral view increase in diameter on the short distal segments. The longest cirrus segment (the transition segment) is about twice as long as broad.

The radials are visible as short and broad, more or less irregular, tubercles between the centrodorsal and the IBr_1; one or two tubercles springing from them are visible in the angles of the calyx over the ends of the basal rays, and there may be a smaller tubercle between these and the central tubercle. The central tubercle is indicated in Carpenter's figure but is not clearly shown.

The ends of the basal rays are visible as small low rhombic tubercles in the interradial angles; they are more or less obscured by the tubercles arising from the radials above them and by the cirri beneath.

The proximal border of the IBr_1 is turned outward and more or less scalloped; the median third of this border is straight and parallel with the proximal border of the centrodorsal; the lateral thirds slant outward and upward and are slightly concave;

the edge of this eversion is thickened and smooth. The lateral portions of the distal border of the IBr_1 are also everted, but not nearly so prominently as the proximal border. The IBr_1 are verly slightly longer than those in the *Challenger* specimens, and the distal border is not quite so much incised; this undoubtedly is due to the smaller size of these individuals.

The IBr_2 (axillaries) are not quite twice as broad as long; the proximal edge is slightly straighter than in the *Challenger* specimens, and is slightly everted. The lateral borders of the elements of the IBr series and of the first brachials, and the inner borders of the first two brachials, are laterally produced.

P_1 is greatly enlarged with 12 or 13 segments of which the first eight or nine are sharply flattened on the outside, the ventral border being somewhat produced; the second and third segments are strongly carinate on the inner ventral border, especially the third, but from this point on the carination rapidly diminishes in extent, disappearing three or four segments later. On the second segment this carination is parallel to the dorsoventral plane, but it gradually becomes recumbent so that on the fourth it is at right angles to this plane.

The brachials beyond the tenth are triangular, about as long as broad, with very finaly spinous distal margins. The dorsal line of the arms is smooth in profile.

A specimen from *Albatross* station 5256 was described as a new species under the name of *Crotalometra eupedata* in the following terms.

The centrodorsal is large and conical, 5 mm. broad at the base and 5 mm. high, with the bare polar area forming the apex of the cone. The cirrus sockets are arranged in 10 columns of one or two each, which are usually succeeded by one or two obsolete and more or less obliterated ones. The columns are on the outer borders of the radial areas so that the columns of adjacent radial areas are in close apposition while the two columns in each area are separated by a median space which is about equal to their own width.

The cirri are X–XX, 66, 90 mm. in length. The first 3 segments are two and one-half times as broad as long, the fourth is twice as broad as long, the fifth is half again as broad as long, and the sixth is slightly longer than broad. The seventh is a transition segment, dull in the proximal three-fourths but highly polished and laterally compressed in the distal fourth, not quite twice as long as broad. The eighth–eleventh or –twelfth segments are about twice as long as broad, and those following gradually decrease in length, becoming about as long as broad at about the twentieth, and twice as broad as long distally. After the fifteenth the distal dorsal edge of the segments begins to project slightly, though this is scarcely noticeable until the twentieth is reached, after which it increases in height, becoming more sharply rounded in end view and arising from the whole dorsal surface of the segment, so that the dorsal profile of the terminal third of the cirri is strongly serrate. The opposing spine is a blunt tubercle with the apex subterminal, arising from the entire dorsal surface of the penultimate segment. The terminal claw is very long and slender, twice as long as the penultimate segment, and only slightly curved. All of the cirrus segments have the distal ends all around slightly projecting and very finely spinous, making the cirri rough to the touch. This projection is slightly more marked on the ventral side than laterally.

The disk is covered with small plates which are very thickly set near the ambulacral grooves but become more scattered toward the periphery in the interambulacral areas.

The ambulacral grooves themselves are bordered with large regular plates. The plating on the brachial and pinnule ambulacra is very highly developed. The perisome of the arms is completely covered with rather large plates so that the arms and pinnules, when the covering plates are closed down, are completely encased in a calcareous covering.

The ends of the basal rays are visible as small, though prominent, tubercles in the interradial angles of the calyx.

The radials are of uniform width all around the calyx, short, somewhat over four times as broad as long, with the distal border set with small scattered spines. The IBr_1 are short, of uniform height, with the proximal border convex and the distal concave, about three times as broad as long; the proximal edge is slightly prominent, and the lateral edges are in very close apposition and rather prominently everted, the crest of the resultant ridge being finely spinous. The IBr_2 are broadly pentagonal, about twice as broad as long, with the lateral edges about as long as those of the IBr_1 and everted and finely spinous like those of that ossicle. Like the IBr_1 and the first two brachials it bears a single small but rather prominent rounded tubercle near each lateral margin.

The 10 arms are stout and rugged but becoming slender distally, 150 mm. in length. The first brachials are longer exteriorly than interiorly, with the distal border concave, the interior edges closely united, and the exterior edges everted and spinous like the lateral edges of the preceding ossicles. The second brachials are about twice as large as the first, irregular in shape, with the proximal border strongly convex; they are in close apposition with their neighbors and strongly flattened against them, and both the exterior and interior edges are everted and spinous. The first syzygial pair (composed of brachials 3+4) is half again as broad as long, laterally flattened both exteriorly and interiorly, with the lateral edges less strongly everted than those of the preceding ossicles. The succeeding five brachials are approximately oblong, about 3 times as broad as long and rather strongly tubercular, those after the twelfth becoming triangular and about as long as broad, this proportion remaining unchanged until near the arm tips where the brachials become wedge-shaped and somewhat longer. The distal edges of the brachials in the outer two-thirds of the arms are overlapping and finely spinous.

Syzygies occur between brachials 3+4, again from between brachials 14+15 to between brachials 17+18, and distally at intervals of from 4 to 10 (usually 6 or 7) muscular articulations.

P_1 is large and very stout, strongly flattened exteriorly, composed of 17–18 segments all of which are broader than long; the pinnule tapers rather rapidly after the proximal third so that the terminal portion is delicate with very small segments. P_2 is 7 mm. long, stout basally, though not nearly so stout as P_1; it tapers rapidly, so that the distal half is slender, and is composed of 14 segments of which the first 3 are broad, the fourth is about as long as broad, and the remainder are somewhat longer than broad. The first 6 segments of P_1 have the distal side very strongly concave, forming 2 sharp keels, one external along the flattened outer side, the other internal; the external keel is armed with fine spines. The distal segments are prismatic, with the angles somewhat produced. P_2 has a similar double carination but, while the exterior keel is much lower, it persists in a raised and very spinous line to the tip of the pinnule; the ends of the distal segments are much more spinous than is the case in

P_1. P_3 is 6 mm. long, more slender than P_2, bearing about the same proportion to that pinnule as it does to P_1, with 12 segments which at first are broad, becoming about as long as broad on the fifth, and longer than broad distally. The pinnule is strongly prismatic, the ridges and the distal ends of the segments being spinous, but the 2 basal keels are only slightly marked. P_4 and the following pinnules are similar to P_3 but slightly more slender with the segments proportionately slightly longer. The distal pinnules are 12 mm. long, rather stout, strongly prismatic, with 18 segments of which the first is crescentic, the second is strongly trapezoidal, about as broad as the greater (proximal) length, and the remainder are about half again as long as broad. The external ridge is somewhat produced and is finely spinous.

Of the three specimens from Menado Bay, Celebes, one is fragmentary with the cirri stout and about 80 mm. long, and the other two are small, one with the cirri about 65 mm. long.

Localities.—*Albatross* station 5236; off the east coast of Mindanao, Philippines; Magabao Island (S.) bearing N. 85° W., 9.1 miles distant (lat. 8°50′45″ N., long. 126° 26′52″ E.); 903 meters; bottom temperature 5.1° C.; fine gray sand; May 11, 1908 [A. H. Clark, 1909, 1911, 1912, 1913, 1918] (1, U.S.N.M., 25462).

Challenger station 214; off the Meangis Islands, southeast of Mindanao, Philippines (lat. 4°33′ N., long. 127°06′ E.); 914 meters; bottom temperature 5.44° C.; blue mud; February 10, 1875 [P. H. Carpenter, 1888; Hartlaub, 1895; A. H. Clark, 1907, 1909, 1912, 1913, 1918] (2, B. M.).

Siboga station 122; east of northern Celebes (lat. 1°58′30″ N., long. 125°00′30″ E.); 1,165–1,264 meters; stone; July 17, 1899 [A. H. Clark, 1918] (4, U.S.N.M., E. 3216; Amsterdam Mus.).

Menado Bay, northern Celebes (lat. 1°31′N., long. 124°47′ E.); 457 meters; Captain Christiansen, Great Northern Telegraph Company, March 12, 1913 (3, C. M.).

Geographical range.—From Mindanao to northern Celebes.

Bathymetrical range.—From 457 to 1,165 (?1,264) meters.

Thermal range.—From 5.1° to 5.44° C.

History.—*Antedon valida* was described and figured by Dr. P. H. Carpenter in his report on the comatulids of the *Challenger* expedition published in 1888, his material consisting of two mutilated individuals and one younger from station 214. Dr. Clemens Hartlaub in 1895 discussed its systematic and bathymetrical relationships and compared it with his new species *Antedon* (*Thalassometra*) *agassizii*.

In my first revision of the old genus *Antedon* published in 1907 I placed *valida* in the new genus *Thalassometra*, and in my revision of the family Thalassometridae published in 1909 I listed *Antedon valida* among the species I was not able to allocate satisfactorily. Later in 1909 I described *Crotalometra eupedata* from a single specimen from *Albatross* station 5236. In the original description a young individual with arms 60 mm. long possessing one IIBr 4(3+4) series was listed from station 5116. In 1911 I compared *C. eupedata* with the new species *C. propinqua*. I said that in *C. eupedata* the second and following brachials are thickly covered with minute spines, but they are evenly distributed over the entire surface, lateral as well as dorsal, and they are neither so large nor so long as in *C. propinqua*. In the same paper I determined as *Thalassometra* (*Oceanometra*) *annandalei* the small specimen from *Albatross* station 5116 originally identified as *C. eupedata*. In my memoir on the crinoids of the Indian

Ocean published in 1912 *Crotalometra eupedata* and *C. valida* were listed, and the synonymy and range of each were given. In a paper on the crinoids of the British Museum published in 1913 notes were given on two specimens of *Aglaometra valida* from *Challenger* station 214, and this form was compared with *A. eupedata*. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *valida* and *eupedata* were included in a key to the species of *Aglaometra*, and the synonymy and range of each was given.

AGLAOMETRA INCERTA (P. H. Carpenter)

[See vol. 1, pt. 2, pl. 14, fig. 1062, pl. 27, fig. 1166.]

Antedon incerta P. H. Carpenter, *Challenger* Reports, Zoology, vol. 11, part 32, 1884, pp. 57, 83 (occurrence of ambulacral grooves on the genital pinnules), pl. 54, figs. 6, 7; vol. 26, part 60, 1888, p. 106 (description; *Challenger* station 170A), pl. 18, fig. 4, 5.—Bateson, Materials for the study of variation, 1894, p. 421 (abnormal specimen).—Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (systematic and bathymetrical relationships).—Hutton, Index faunae Novae Zealandiae, 1904, p. 290 (listed).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 18 (not placed in a revision of the Thalassometridae); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 404 (referred to *Crotalometra*); Crinoids of the Indian Ocean, 1912, p. 33 (of P. H. Carpenter, 1888 = *Crotalometra incerta*).

Thalassometra incerta A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed).

Crotalometra incerta A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (= *Antedon incerta* P. H. Carpenter, 1888), p. 209 (synonymy).

Aglaometra incerta A. H. Clark, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 47 (published references to specimens in the B. M.; *Challenger* station 170A; character of the IBr series); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 163 (in key; range), p. 165 (references).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 7, No. 29 (*Challenger* station 170a; notes; perhaps a *Thalassometra*).

Diagnostic features.—The elements of the IBr series and lower brachials are in close lateral contact; the proximal portion of the animal is broadly rounded, the profiles of the axillaries making with each other an angle of approximately 90°, but the arm bases being nearly parallel; and the cirri are long and stout, somewhat more than half as long as the arms. The 10 arms are 90 mm. long, and the cirri are 50 mm. long with 70 segments.

Description.—The centrodorsal is bluntly conical with the interradial angles at the base slightly produced. The cirrus sockets are arranged in 10 columns, two to a column, the two columns in each radial area being apparently either in apposition or more or less separated in the midradial line.

The cirri are about XX, nearly 70, sometimes reaching 50 mm. in length. The ninth-twelfth segments are longer than broad, and those following gradually shorten and develop a dorsal keel which is most marked in the middle third.

The radials are barely visible. The elements of the IBr series are somewhat sharply carinate. The IBr_2 (axillaries) and first brachials have sharp edges and flattened sides. The second brachials and the hypozygals of the first syzygial pairs are flattened on the inner side only. The articular line between the first two brachials is somewhat tubercular.

The 10 arms are probably about 90 mm. long and are composed of tolerably smooth subtriangular brachials which gradually become quadrate.

Syzygies occur between brachials 3+4, again from between brachials 16+17 to between brachials 21+22, and distally at intervals of from 8 to 16 muscular articulations.

The lower pinnules are stout with broad carinate segments; they diminish in size from the second to the seventh brachial and then increase slowly. The later pinnules are styliform with the two basal segments slightly expanded. The basal segments of P_1 have their outer sides somewhat flattened, and the third-fifth have their inner edges truncated so as to be flattened against the arm.

The disk is about 10 mm. in diameter and is thickly covered with plates which extend out on to the arms at the sides of the ambulacra and also over the gonads. The pinnules have well-defined side- and covering-plates, most of the former being notched for the presence of sacculi which are small, but pretty regularly distributed.

The color in alcohol is dirty yellowish white.

Notes.—Carpenter said that this is a smaller species than *A. valida;* the cirri, though containing the same number of segments, do not reach more than 50 mm. in length as compared with 80 mm. in that species. The flattening of the outer side of the basal pinnules is not so evident, and the lower segments of the distal pinnules show but little trace of the expanded trapezoidal form that is so characteristic of *A. valida.* The sacculi, too, are much more abundant than in the latter species, the side plates being notched for their reception. The ambulacra extend onto the genital pinnules, as is also the case in *A. valida,* but the plates covering the gonads are much less developed than in the species like *Poecilometra acoela,* which have no ambulacra on these pinnules.

I examined the single specimen of *A. incerta* at the British Museum in 1910. This is a large and robust species; the edges of the ossicles of the IBr series are spinous; the well developed synarthrial tubercles resemble those of certain species of *Psathyrometra.*

Prof. Torsten Gislén examined this specimen in 1925 and published notes on it in 1928. He said that the synarthrial tubercles are carinate and the brachials are bordered with spines. He suggests that it is perhaps a *Thalassometra.*

Abnormality.—In the single known specimen one of the postradial series lacked the IBr_1, the IBr_2 (axillary) immediately following the radial. This axillary is smaller and more triangular than the other axillaries so that the pair of first brachials which it bears are in close lateral contact with the axillaries of the postradial series on either side.

Locality.—*Challenger* station 170A; near the Kermadec Islands, north of New Zealand (lat. 29°45′ S., long. 178°11′ W.); 1,152 meters; bottom temperature 4.17° C.; volcanic mud; July 14, 1874 [P. H. Carpenter, 1884, 1888; Bateson, 1894; Hartlaub, 1895; Hutton, 1904; A. H. Clark, 1907, 1909, 1912, 1913, 1918; Gislén, 1928] (1, B. M.).

History.—*Antedon incerta* was first mentioned by Dr. P. H. Carpenter in his report upon the stalked crinoids of the *Challenger* expedition published in 1884. Carpenter gave a specific formula for the species following Bell's method as modified by himself, and noted that in this species, although the genital pinnules are protected by a very close and regular pavement of anambulacral plates, the ambulacra extend over these plates in the usual way. He noted that in *Antedon incerta* the protecting anambucral plates are smaller and more irregular than they are in *Antedon* (*Poecilometra*) *acoela*. He figured a side view of a genital pinnule with its ambulacrum, and the ambulacral skeleton of an arm and the bases of six pinnules. In his report upon the comatulids of of the *Challenger* expedition published in 1888 he described and figured *A. incerta* in detail.

Prof. William Bateson mentioned the abnormal postradial series of the type specimen in 1894, and in 1895 Dr. Clemens Hartlaub discussed the systematic and bathymetrical relationships of the species. Capt. Frederick Wollaston Hutton listed *Antedon incerta* among the echinoderms found in the New Zealand seas in 1904.

In my first revision of the genus *Antedon* published in 1907 *incerta* was assigned to the new genus *Thalassometra*. In my revision of the family Thalassometridae published in 1909 *Antedon incerta* was listed among the species I was unable to place satisfactorily. In another paper published later in the same year *incerta* was referred to the new genus *Crotalometra*. In my memoir on the crinoids of the Indian Ocean published in 1912 *Crotalometra incerta* was listed and the range and synonymy were given, and in a paper on the crinoids of the British Museum published in 1913 I gave brief notes on the type specimen of *Aglaometra incerta*, which I had examined in 1910. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *incerta* was included in the key to the species of *Aglaometra*, and the synonymy and range were given.

In 1928, Prof. Torsten Gislén, who had examined the type specimen in 1925, published brief notes on *Aglaometra incerta* and suggested that perhaps it is a species of *Thalassometra*.

AGLAOMETRA PROPINQUA (A. H. Clark)

PLATE 15, FIGURE 47

Crotalometra propinqua A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 549 (description; *Albatross* station 5424; also stations 5274, 5445); Zool. Anz., vol. 39, No. 11/12, 1912, p. 427 (compared with *C. sulcata*); Crinoids of the Indian Ocean, 1912, p. 209 (synonymy; locality).

Crotalometra vera A. H. CLARK, Zool. Anz., vol. 39, No. 11/12, 1912, p. 427 (description; *Siboga* station 173).

Aglaometra vera A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 163 (in key; range), p. 165 (description; station 173), p. 274 (listed), pl. 21, fig. 54.

Aglaometra propinqua A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 163 (in key; range), p. 165 (references).

Diagnostic features.—The cirri are rather slender, less than half the arm length; the division series and lower brachials are in close lateral contact; and the proximal portion of the animal is broadly rounded. The 10 arms are 130 mm. long, and the cirri are 45–60 mm. long with 59–69 segments.

Description.—The centrodorsal is moderate in size, conical, the sides slightly convex, 5.5 mm. broad at the base and 4.5 mm. high to 4.5 mm. broad at the base and 3.5 mm. high, the tip somewhat truncated. The cirrus sockets are arranged in 10 columns, two or three to a column; the columns are slightly separated in the midradial line and in close apposition interradially.

The cirri are XX, 59–64, from 45 to 55 mm. long, moderately stout, though not nearly so stout as those of *A. cupedata;* the first three segments are short, the fourth or fifth as long as broad; the fifth, sixth, or seventh (usually the sixth) is a transition segment, half again as long as broad. The following segments gradually decrease in length, becoming about as long as broad on the fourteenth–sixteenth, and distally twice as broad as long. Shortly after the transition segment the distal dorsal edge of the segments begins to become produced, rising up to form a sort of gable, which leans somewhat inward, with serrate sides and a blunt tubercle at the apex, but the dorsal surface of the segments does not become generally carinate as is usually the case.

The ends of the basal rays are visible as prominent, though small, tubercles in the angles of the calyx.

The radials are just visible beyond the edge of the centrodorsal; they are more or less covered with fine spines and have a finely serrate distal border. The IBr_1 are very short, about four times as broad as long, convex proximally, concave distally. The IBr_2 (axillaries) are rhombic with the sides concave, twice as broad as long, the lateral edges shorter than those of the IBr_1. The elements of the IBr series and first two brachials have somewhat everted and finely spinous edges, sometimes also scattered fine spines on the dorsal surface and a thick development of fine spines along the lateral margins, which are somewhat produced.

The 10 arms are 130 mm. long. The first brachials are short, twice as broad as long exteriorly, somewhat incised on the distal margin. The broadly rounded synarthrial tubercles are moderately prominent. The second brachials are larger with a rounded posterior process incising the first. The first syzygial pair (composed of brachials 3+4) is from one-third to one-half again as broad as long and oblong. The next four brachials are oblong, about two and one-half times as broad as long, those following becoming obliquely wedge-shaped and then triangular, as long as broad, and wedge-shaped again distally. The earlier brachials have everted and finely spinous distal ends. The fourth and following brachials have the dorsal, but not the lateral, surface thickly covered with fine spines which on the outer brachials become somewhat coarser and are directed distally. Proximally as the brachials become wedge-shaped the distal edge begins to overlap and the proximal edge to lose its eversion so that the later brachials acquire strongly produced and very spinous distal ends.

Notes.—In the original description I said that in *A. eupedata* (=*valida*) the second and following brachials are thickly covered with minute spines, but these are evenly distributed over the entire exposed surface, lateral as well as dorsal, and they are neither so large nor so long as in this species.

The specimen from *Albatross* station 5274 is somewhat larger than the others, with the arms about 150 mm. in length.

Crotalometra vera was briefly described as follows:

The cirri have 62–69 segments and are 60 mm. long. The longest cirrus segments are from one-third to one-half again as long as broad; the sixth or seventh is a transition segment.

The edges of the ossicles of the IBr series and of the earlier brachials are only very slightly, if at all, everted and are either armed with exceedingly fine spines or quite smooth. The spines within the distal angle of the axillaries and on the dorsal surface of the ossicles are exceedingly short and fine and difficult to detect.

The 10 arms are about 130 mm. long.

Except for the features noted this species agrees with *A. propinqua*.

Localities.—*Albatross* station 5274; China Sea in the vicinity of southern Luzon; Malavatuan Island (N.) bearing S. 73°30′ E., 17.5 miles distant (lat. 13°57′30″ N., long. 120°03′25″ E.); 960 meters; bottom temperature 5.2° C.; gray mud and sand; July 16, 1908 [A. H. Clark, 1911, 1912, 1918] (1, U.S.N.M., 35579).

Albatross station 5445; off the east coast of Luzon· Atalaya Point, Batag Island, bearing S. 56° E., 5.3 miles distant (lat. 12°44′42″ N., long. 124°59′50″ E.); 700 meters; bottom temperature 6.8° C.; green mud and sand; June 3, 1909 [A. H. Clark, 1911, 1912, 1918] (1, U.S.N.M., 35581).

Albatross station 5424; Joló (Sulu) Sea; Cagayan Island (S.) bearing S. 11° W., 3.4 miles distant (lat. 9°37′05″ N., long. 121°12′37″ E.); 622 meters; bottom temperature 10.2° C.; coral sand; March 31, 1909 [A. H. Clark, 1911, 1912, 1918] (2, U.S.N.M., 27498, 35578).

Siboga station 173; Ceram Sea (lat. 3°27′00″ S., long. 131°00′30″ E.); 567 meters; fine yellow gray mud; August 28, 1899 [A. H. Clark, 1912, 1918] (2, U.S.N.M., E. 397; Amsterdam Mus.).

Geographical range.—From the northern Philippines to the southern Moluccas.

Bathymetrical range.—From 567 to 960 meters.

Thermal range.—From 5.2° to 10.2° C.

History.—*Crotalometra propinqua* was described in 1911 from two specimens from *Albatross* station 5424; at the same time one specimen was recorded from station 5274, and one from station 5445. In a paper including preliminary descriptions of new species collected by the *Siboga* expedition published in 1912 *Crotalometra propinqua* was compared with *C. sulcata*, sp. nov., and *Crotalometra vera*, sp. nov., was described from two specimens from *Siboga* station 173. In my memoir on the crinoids of the Indian Ocean published later in 1912 I listed *Crotalometra propinqua*, giving the synonymy and range. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *propinqua* and *vera* were included in a key to the species of *Aglaometra; A. vera* was redescribed and figured, and the synonymy and range of *A. propinqua* were given.

AGLAOMETRA SULCATA (A. H. Clark)

PLATE 13, FIGURE 40

Crotalometra sulcata A. H. CLARK, Zool. Anz., vol. 39, No. 11/12, 1912, p. 427 (description; *Siboga* station 161).

Aglaometra sulcata A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 163 (in key; range), p. 164 (description; station 161), p. 273 (listed), pl. 21, fig. 53.

Diagnostic features.—The distal angles of the IBr_1 and proximal angles of the axillaries, and the corresponding angles of the first two brachials and of the elements of the first syzygial pairs, are widely cut away, forming large and prominent water pores; and the cirri are moderately slender, slightly more than half the length of the arms. The 10 arms are about 115 mm. long, and the cirri are 60–65 mm. long with 63–64 segments.

Description.—The centrodorsal is columnar in the proximal half, rather low conical in the distal, with the cirrus sockets arranged in 10 columns of usually one fully and one partially developed one each; the two columns in each radial area are more or less separated in the midradial line.

The cirri are X, 63–64, from 60 to 65 mm. long. The eighth–fourteenth segments are about twice as long as broad; those in the distal third of the cirri are about half again as broad as long with prominent dorsal spines.

The ossicles of the IBr series and lower brachials are almost smooth. The distal angles of the IBr_1 and the proximal angles of the IBr_2 (axillaries), and the corresponding angles of the first two brachials and of the elements of the first syzygial pair, are widely cut away forming large and prominent water pores. The edges of the ossicles bordering these water pores are more or less everted and coarsely denticulate, or bear a few coarse spines.

The 10 arms are about 115 mm. long. The dorsal surface of the brachials beyond the first syzygial pair is roughened with numerous short crowded spines.

Syzygies occur between brachials 3+4, again from between brachials 14+15 to between brachials 16+17, and distally at intervals of from 4 to 8 muscular articulations.

Notes.—In the specimen from Menado Bay, Celebes, one IIBr 2 series is present so that there are 11 arms.

Localities.—*Siboga* station 161; Halmahera Sea, west of Waigeu (lat. 1°10′30″ S., long. 130°09′00″ E.); 798 meters; muddy sand; August 17, 1899 [A. H. Clark, 1912, 1918] (1, Amsterdam Mus.).

Menado Bay, northern Celebes (lat. 1°31′ N., long. 124° 47′ E.); 457 meters; Captain Christiansen, Great Northern Telegraph Company, March 12, 1913 (1, C. M.).

Geographical range.—From the Halmahera Sea west of Waigeu northward to Menado Bay, Celebes.

Bathymetrical range.—From 457 to 798 meters.

History.—This species was described in 1912 under the name of *Crotalometra sulcata*. It was redescribed and figured as *Aglaometra sulcata* in 1918.

Genus STIREMETRA A. H. Clark

Antedon (part) P. H. Carpenter, Proc. Roy. Soc. Edinburgh, vol. 12, 1884, p. 368, and following authors.

Thalassometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 359.

Stiremetra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 15 (diagnosis; genotype *Antedon acutiradia* P. H. Carpenter, 1888); Mem. Australian Mus., vol. 4, 1911, pp. 730, 731 (in key), p. 735 (one species in Australia), p. 789 (original reference; characters; range); Crinoids of the Indian Ocean, 1912, p. 10 (absent from Japan), p. 11 (absent from the west coast of the Malay Peninsula, the Andamans, and from farther west), p. 24 (range), p. 59 (in key), p. 210 (original reference; type); Die Crinoiden der Antarktis, 1915, p. 125 (the component species show the characteristic features of *Anthometra adriani*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 146 (in key; range), p. 160 (key to the included species); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range).—Gislén, Vid. Medd. Dansk naturh. Foren. København, vol. 83, 1927, p. 6.—Mortensen, Handbook of the echinoderms of the British Isles, 1927, p. 25 (occurrence in northeast Atlantic; in key).—Nobre, Echinodèrmes de Portugal, 1931, p. 163 (diagnosis).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.—Nobre, Echinodèrmes de Portugal, 1938, p. 185 (in key), p. 186.

Diagnosis.—A genus of Thalassometridae in which the arms are dorsally rounded to the tips and are 10–14 (rarely more than 10) in number, with the IIBr series 2 or 4(3+4); the division series and arm bases are carinate or subcarinate, smooth dorsally and with straight sides or sometimes everted edges; the cirri are recurved distally, the short outer segments bearing prominent dorsal spines; there is no appreciable expansion of the earlier segments of the genital pinnules; and the size is small, the arms being 45–80 mm. in length and the cirri 17–50 mm. long with 30–66 segments.

Geographical range.—Hawaiian Islands; Celebes; Fiji; Kermadec Islands; off southeastern Australia; Laccadive Islands; Canary Islands and northward to Cape Carvoeiro, Portugal.

Bathymetrical range.—From 649 (?640) to 2,468 meters.

Thermal range.—From 2.2° to 9.6° C.

Remarks.—The genus *Stiremetra* should be considered as a tentative grouping of a rather heterogeneous assemblage of forms most of which are known from one or a few mutilated individuals.

The included species are all small and delicate, and all are from deep water. Most of the individuals are badly broken in the long journey in the dredge from the bottom to the surface intermixed with other stouter and tougher organisms, and few are recovered in a condition permitting satisfactory description.

Stiremetra lusitanica is a rather anomalous species, though there seems to be no good reason for not considering it congeneric with at least some of the other species included in *Stiremetra*. It is the only species having more than 10 arms, the IIBr series being either 2 or 4(3+4); but the majority of the individuals appear to have 10 arms only. Its centrodorsal is large with the cirri arranged roughly in 15 columns instead of in 10 definite columns, and it is the only species of the genus known from the Atlantic.

Another anomalous species is *S. breviradia* in which the brachials bear long overlapping spines which at first sight suggest those of *Stylometra spinifera*. But the resemblance is undoubtedly superficial, for in its other characters *S. breviradia* agrees with the species grouped in *Stiremetra*.

It is possible that the two species in which the axillaries are shield-shaped and longer than broad, *S. acutiradia* and *S. perplexa*, represent a special group, but both are incompletely known, and in general the length of the axillaries is a variable feature much influenced by growth changes.

Stiremetra spinicirra is remarkable for the great development of the cirrus spines, and *S. decora* is the only species with highly developed ornamentation; it is also the species recorded from the least depth. *Stiremetra carinifera* is known from such fragmentary material that little can be said about it; it is, however, the only representative of the genus known from the Indian Ocean.

KEY TO THE SPECIES IN THE GENUS STIREMETRA

a^1. Cirri with 50–66 segments, six or more of the basal without dorsal spines; IBr series and lower brachials with a rounded median ridge; large, the arms up to 80 mm. long.

b^1. Cirri more or less irregularly arranged on the centrodorsal, roughly in 15 columns; 10–14 (usually 10) arms about 60 mm. long; cirri nearly 30 mm. long with 50–56 segments (Canary Islands to Cape Carvoeiro, Portugal; 1,280 [?914]–2,165 meters) **lusitanica** (p. 121)

b^2. Cirri arranged in 10 columns on the centrodorsal; always 10 arms.

c^1. Brachials beyond the proximal fourth of the arms with the dorsal midline raised and produced distally over the base of the brachials succeeding forming, in lateral view, high and conspicuous curved overlapping spines; IBr series and first two brachials smooth dorsally, with straight sides, the carination low and broad or obsolescent; arms about 80 mm. long; cirri with 40–50+ segments (Fiji to the Kermadec Islands; 1,152–2,285 meters). **breviradia** (p. 126)

c^2. Brachials with the dorsal surface not raised into prominent dorsal overlapping spines.

d^1. Axillaries shield-shaped, very long, half again as long as broad, smooth, very sharply flattened laterally, the edges unmodified; IBr_1 with the central portion of the dorsal surface recumbent, making an angle of approximately 90° with the dorsoventral axis, the edges smooth and unmodified; cirri 35–40 mm. long with 62–66 segments (off Celebes; 1,158 meters) **perplexa** (p. 129)

d^2. IBr$_1$ with the proximal and distal edges prominently everted, smooth, somewhat wavy, or coarsely tubercular, and with a prominent median rounded carination; cirri 45–50 mm. long with 50–64 (usually 57–58) segments (Laccadive Sea; 786 meters) **carinifera** (p. 130)

a^2. Cirri with not more than 45 segments of which all but the basal four or less bear long and conspicuous dorsal spines; elements of the IBr series and first two brachials sharply carinate; small and delicate, the 10 arms not more than 50 mm. long.

b^1. The first four cirrus segments do not bear dorsal spines; the fourth and a few of the following segments are nearly or quite twice as long as broad; arms about 50 mm. long.

c^1. Axillaries longer than broad; IBr series and lower brachials with straight sharp edges, a sharp median carination, and a smooth dorsal surface (off Kandavu, Fiji; 2,468 meters). **acutiradia** (p. 132)

c^2. Axillaries nearly or quite twice as broad as long; IBr$_1$ with two long and rather stout blunt spines, one on the distal and one near the proximal edge, and a similar but shorter spine on each side; axillaries with a high median crest that may be more or less deeply notched in the middle; 30–40 cirrus segments (Hawaiian Islands; 640–649 meters) **decora** (p. 134)

b^2. All, or all but one or two, of the cirrus segments bear high, broad, and conspicuous dorsal spines; a few of the earlier cirrus segments are slightly longer than broad; arms about 45 mm. long; cirri 17 mm. long with 40–45 segments (off Sydney, New South Wales; 1,737 meters). **spinicirra** (p. 136)

STIREMETRA LUSITANICA (P. H. Carpenter)

Comatules Parfait, Rapport sur la campagne scientifique du *Talisman* en 1883, 1884, p. 43 (lat. 33°47′ N., long. 11°23′ W.; 1,635 meters; "comatules jaune soufre").—A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 48.

Antedon lusitanica P. H. Carpenter, Proc. Roy. Soc. Edinburgh, vol. 12, 1884, p. 368 (detailed description; *Porcupine*, 1870, station 17*a*; discussion), p. 372 (*Porcupine*, 1870, station 17*a*); *Challenger* Reports, Zoology, vol. 11, pt. 32, 1884, p. 315 (*Porcupine* station 17*a*, with fragments of *Pentacrinus* [*Annacrinus*] *wyville-thomsoni*); vol. 26, pt. 60, 1888, pp. 109, 217 (description; *Porcupine* station 17*a*; discussion), pl. 39, figs. 1–3; Journ. Linn. Soc. (Zool.), vol. 24, 1891, p. 65 (neighborhood of Madeira, from a submarine cable in 500–700 fathoms; discussion).—Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (in the *Basicurva* group; bathymetrical relationships), p. 135 (compared with [*Thalassometra*] *agassizii*, sp. nov.).—Grieg, Bergens Mus. Aarbog for 1903 (=1904), No. 5, 1904, p. 35.—Minckert, Arch. Naturg., Jahrg. 71, 1905, vol. 1, Heft 1, p. 211 (syzygies; regeneration).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, pp. 1578, 1581 (listed).—Koehler, Résultats des campagnes scientifiques accomplies sur son yacht par Albert 1er Prince souverain de Monaco, fasc. 34, 1909, p. 267 (*Princesse-Alice* stations 806, 1897; 1116, 1236, 1901; 1713, 1904; 2048, 1906), pl. 1, figs. 7, 8, pl. 32, figs. 12–14.—A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 18 (not allocated in the revision of the Thalassometridae).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 309 (in the *Spinifera* group; history).—Mortensen, Handbook of the echinoderms of the British Isles, 1927, p. 25.

Thalassometra lusitanica A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 7 (northwestern coast of Africa), p. 37 (synonymy; Madeira; south of Funchal; off the southeastern coast of Tenerife; near Mogador; between Madeira and Morocco; 900–2,165 meters); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 46 (published references to specimens in the British Museum; *Porcupine* station 17*a*, 1870); Unstalked crinoids of the *Siboga* Exped., 1918, p. 167 (in key; range), p. 171 (references).—Nobre, Echinodèrmes de Portugal, 1931, p. 163.

Antedon (*Crotalometra*) *lusitanica* Koehler and Vaney, Bull. Mus. d'Hist. Nat. Paris, 1910, No. 1, p. 26 (collected by the *Travailleur* or *Talisman*), p. 31 (lat. 33°17′ N., long. 11°23′ W.; 1,635 meters).

Stiremetra lusitanica A. H. Clark, The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range).—Nobre, Echinodèrmes de Portugal, 1931, p. 163 (records).—Mortensen, Handbook of the echinoderms of the British Isles, 1927, p. 25 (localities).—Nobre, Echinodèrmes de Portugal, 1938, p. 186 (description; notes).

Diagnostic features.—The cirri are irregularly arranged on the centrodorsal, roughly in 15 columns; the division series and arm bases are perfectly smooth dorsally with sharp, straight, unmodified lateral edges and the middorsal region roundedly carinate; the 10–14 (usually 10) arms, with the IIBr series either 2 or 4(3+4), are about 60 mm. long, and the cirri, which are rather stout, are nearly 30 mm. long with 50–56 segments.

Description.—The centrodorsal is hemispherical, roughened at the dorsal pole.

The cirri are XII–XV, about 50, nearly 30 mm. long. The first three or four segments are quite short, the three following much longer, and those succeeding longer than broad but becoming gradually shorter up to the fifteenth or twentieth; from this point (or earlier) to the end of the cirri the segments have a well marked dorsal spine which becomes slightly less distinct on those just preceding the terminal claw.

The radials are scarcely visible except sometimes in the interradial angles. The IBr_1 are short and trapezoidal with a strong median ridge which is continued on to the axillaries. The IBr_2 (axillaries) are short, broad, and pentagonal with slight backward projections in the middle of the proximal border. The axillaries and first two brachials have sharp straight edges and flattened sides. The IIBr series (when present) are 2.

The 10–12 (usually 10) arms are about 60 mm. long, with smooth elongate brachials. The first brachials are not much incised, and the outer portions of their dorsal surface are usually much less convex than the remainder. The second brachials project more or less proximally into the first. They and the first syzygial pairs (composed of brachials 3+4) are somewhat flattened on the inner side. The three following brachials are squarish, those following more elongated with very oblique ends.

Syzygies occur between brachials 3+4 and 15+16 or 16+17.

P_1 is moderately long with about 15 broad segments. The lower segments are stout and wide with the outer sides somewhat flattened; the second and three or four following segments have their inner edges produced into strong and prominent keels which are slightly folded upward; these keels are continued, though less developed, on to the later segments. The pinnules following are altogether smaller, consisting of but a few slender segments.

The disk is 5 mm. in diameter and is thickly covered with numerous small plates, those at the sides of the ambulacra being rather more regularly arranged than the rest. The pinnule ambulacra are not well defined, but the sacculi are moderately developed.

The color in alcohol is brownish or greenish white.

Notes.—The preceding description is adapted from Carpenter's original description published in 1884, supplemented with additional information from his redescription published in 1888.

According to Koehler all the specimens from *Princesse-Alice* stations 1236 and 1713 had 10 arms. Of the three specimens from *Princesse-Alice* station 2048 two had 10 arms and one had 11. Of the specimens from *Princesse-Alice* station 806 nine had 10 arms; in four all the arms were broken off at the first syzygy; three had more than 10 arms, one having 11, one 12, and one 13.

Koehler said that the specimens collected by the *Princesse-Alice* were in general incomplete, and in many of them the arms were broken off at the first syzygy so that the number of arms may have been greater than that given. He noted that Carpenter, who had carefully studied this species, directed attention to the variability in the number of arms. The normal number appears to be 10, though it may be more, in which case the IIBr series are 2, or sometimes 4(3+4). He remarked that Carpenter cited the case of an individual collected by the *Challenger* (in reality the *Porcupine*) with two IIBr 2 series and at least 12 arms, and in a paper published in 1891 Carpenter recorded an individual with at least 14 arms and with both IIBr 2 and IIBr 4(3+4) series.

Koehler said that the first syzygy is between brachials 3+4 and the second usually between brachials 13+14; those following occur at intervals of 4 or 5 muscular articulations.

Carpenter said that Mr. Johnson's specimens from near Madeira are larger than those obtained by the *Porcupine*, one of the cirri having 56 segments. One individual may have had only 10 arms. A second had 11 and perhaps more, but most of them are broken at the base, only one IIBr 2 series being left. The third had 14 or more arms, there being one IIBr 2 series and three IIBr 4(3+4) series remaining; of the six arms following the three IIBr 4(3+4) series three have the first syzygy between brachials 1+2, and in the other three there is a syzygy between brachials 2+3.

Nearly all the 10 specimens dredged by the *Porcupine* had the arms broken off at the first syzygy, and Carpenter said it was therefore quite possible that the epizygal of this syzygial pair might sometimes have been a IIBr axillary. He noted that in one specimen there are two IIBr 2 series.

Localities.—*Princesse-Alice* station 1713; off Tenerife, Canary Islands (lat. 28°04′ N., long. 16°49′30″ W.); 1,330–1,340 meters; August 1, 1904 [Koehler, 1909; A. H. Clark, 1911, 1923; Mortensen, 1927].

Princesse-Alice station 1116; off Cape Ghir (Ras Aferni), Morocco (lat. 31°43′30″ N., long. 10°46′45″ W.); 2,165 meters; globigerina ooze; July 11, 1901 [Koehler, 1909; A. H. Clark, 1911, 1923; Mortensen, 1927].

Princesse-Alice station 2048; off Funchal, Madeira (lat. 32°32′30″ N., long. 17°02′ W.); 1,968 meters; July 31, 1905 [Koehler, 1909; A. H. Clark, 1911, 1923; Mortensen, 1927].

Princesse-Alice station 1236; off Funchal, Madeira (lat. 32°34′ N., long. 17°02′45″ W.); 1,500 meters; September 8, 1901 [Koehler, 1909; A. H. Clark, 1911, 1923; Mortensen, 1927].

Princesse-Alice station 806; off Machico, Madeira (lat. 32°39′20″ N., long. 16°40′55″ W.); 1,425 meters; July 4, 1897 [Koehler, 1909; A. H. Clark, 1911, 1923; Mortensen, 1927].

In the neighborhood of Madeira, from a submarine cable belonging to the Brazilian Submarine Telegraph Co.; 914–1,280 meters; J. Y. Johnson [P. H. Carpenter, 1891; Hartlaub, 1895; Koehler, 1909 (as "côtes du Brézil"); A. H. Clark, 1911, 1923; Mortensen, 1927].

Talisman; west of Cape Blanco, Morocco (lat. 33°17′ N., long. 11°23′ W.); 1,635 meters; June 14, 1883 [Parfait, 1884; Koehler and Vaney, 1910; A. H. Clark, 1911, 1923; Mortensen, 1927].

Porcupine station 17*a*; off Cape Carvoeiro, Portugal (lat. 39°39′ N., long. 9°39′ W.); 1,353 meters; bottom temperature 9.6° C.; 1870 [P. H. Carpenter, 1884, 1888, 1891; Hartlaub, 1895; Grieg, 1904; A. H. Clark, 1913, 1923; Mortensen, 1927] (3, B. M.).

Geographical range.—From the Canary Islands northward to Cape Carvoeiro, Portugal.

Bathymetrical range.—From 1,280 (?914)–2,165 meters; the average of 8 records is 1,491 meters.

Thermal range.—One record, 9.6° C.

History.—This species was described as *Antedon lusitanica* by Dr. P. H. Carpenter in 1884 from 10 mutilated specimens that had been dredged by the *Porcupine* in 1870. Carpenter said that this species seems to be dimorphic, like *Actinometra* (*Neocomatella*) *pulchella*, and to constitute another exception to the general rule that 10-armed types are sharply separated from those in which the primary arms divide. He remarked that the length and spiny character of its cirri, and the peculiarities of its pinnules, readily distinguish it from all the species of *Antedon* hitherto described. But, he said, it has many points of resemblance to some of those dredged by the *Blake* in the Caribbean Sea. It is a type of some interest for two reasons. It is the only European comatulid which is in the condition of the so-called recent cystid, *Hyponome sarsii* (=*Zygometra microdiscus*), with a plated disk and the ambulacra converted into tunnels by the folding down of the plates at their sides; and it is the only European *Antedon* with more than 10 arms.

In 1884 also Capt. Jacques Théophile Parfait in a report on the scientific investigations of the French steamer *Talisman*, of which he was the commanding officer, in 1883 mentioned some "comatules jaune soufre" from lat. 33°47′ [=17′] N., long. 11°23′ W., in 1,635 meters.

In the *Challenger* report on the stalked crinoids published in 1884 Carpenter said that a few fragments of stems and arms of *Pentacrinus* (*Annacrinus*) *wyville-thomsoni* had been dredged with the ten specimens of *Antedon lusitanica* from *Porcupine* station 17*a*. In the *Challenger* report on the comatulids published in 1888 Carpenter redescribed and figured *Antedon lusitanica* and discussed the occurrence of two IIBr 2 series in one of the ten specimens at length. He remarked that sacculi are present and fairly well developed. He said that the nearest ally of *lusitanica* is undoubtedly *Antedon* (*Stiremetra*) *breviradia* from the South Pacific. He noted that both species have the ossicles of the IBr series short and broad, this being especially the case in *lusitanica*, while in most examples of *lusitanica* the margin of the axillaries and first brachials is much less rounded than the rest of the dorsal surface and seems to stand off from it as a lateral process, a character which is scarcely perceptible in *breviradia*. He said that P_1 is also different. The keels on the inner edges of the lower segments in *lusitanica* are less prominent than in *breviradia*, but at the same time they are more distinctly separated from each other, and the earlier cirrus segments are relatively longer.

In 1891 Carpenter recorded three specimens of *Antedon lusitanica* that had been brought up on a cable belonging to the Brazilian Submarine Cable Co. from a depth of 500–700 fathoms in the neighborhood of Madeira and sent to him by J. Y. Johnson, of Funchal. With these was found *Annacrinus wyville-thomsoni*, as had been the case at the original *Porcupine* station. Carpenter thought it very probable that the comatulids obtained by the *Talisman* in depths of about 1,200 meters off the Azores and Canaries, in 2,200 meters off Agadir, and in 2,330 meters near the Cape Verde Islands may belong to the same deep sea type. He said that the former, however, might possibly also include *Antedon* (*Leptometra*) *phalangium* "which is now known to extend down to at least 500 fathoms." Carpenter called attention to the similarity in the arm division between *Antedon* (*Stiremetra*) *lusitanica* and *A.* (*Thalassometra*) *multispina* and said that should IIBr 4(3+4) series prove to be common in these two species it may become necessary to unite them under one name. At present, he said, the main points of difference between them, apart from the characters of the arm divisions, appear to lie in the longer cirri and less spinous arms of *lusitanica*, in which also the segments of the genital pinnules, as the Madeira specimens show, are somewhat produced upward on the outer side as is so markedly the case in *Antedon* (*Charitometra*) *basicurva;* but, he said, there is nothing of this kind in *multispina*.

In a survey of the *Basicurva* group published in 1895 Dr. Clemens Hartlaub listed *Antedon lusitanica*, giving the locality and depth, and in 1904 Dr. James A. Grieg also mentioned it as a member of the *Basicurva* group. Dr. Wilhlem Minckert in 1905 listed it as one of the species of the *Basicurva* group falling also in the *Spinifera* and *Granulifera* groups.

In my first revision of the genus *Antedon* published in 1907 *lusitanica* was transferred to the new genus *Thalassometra*. In my revision of the family Thalassometridae published in 1909 *Antedon lusitanica* was listed among the species I was unable to place satisfactorily.

In 1909 Prof. René Koehler recorded numerous specimens of *Antedon lusitanica* from the dredgings of Prince Albert of Monaco's yacht *Princesse-Alice*, several from station 806 (cruise of 1897), an isolated disk from station 1116 (1901), one from station 1236 (1901), one from station 1713 (1904), and three from station 2048 (1906). He gave figures of two specimens showing the color in life—bright clear yellow—a figure of a 13-armed specimen from station 806 with the IIBr series both 2 and 4(3+4), a figure of a 10-armed specimen, and a figure of a specimen with the arms broken off at the first syzygy but with almost all the cirri intact. He said that *Antedon lusitanica* had been discovered by the *Challenger* (in reality the *Porcupine*) off Cape Carvoeiro, and was rediscovered by the *Princesse-Alice* in neighboring regions. He added that this species is also found on the opposite coasts of the Atlantic, as Carpenter identified it on a fragment of broken cable coming from the coast of Brazil. This refers to Carpenter's record from the vicinity of Madeira.

In 1910 Profs. René Koehler and Clement Vaney recorded, without comment, four specimens of *Antedon* (*Crotalometra*) *lusitanica*, collected by the *Talisman* in lat. 33°17′ N., long. 11°23′ W. in 1,635 meters, thus identifying the "comatules jaune soufre" mentioned by Captain Parfait in 1884.

In a paper on the crinoids of the African coasts published in 1911 I listed *Thalassometra lusitanica* and gave the synonymy and the localities from which it is known. Dr. Clemens Hartlaub in 1912 listed *Antedon lusitanica* as a member of the *Spinifera* group. In a paper on the crinoids of the British Museum published in 1913 I noted that I had seen three specimens of *Thalassometra lusitanica* from *Porcupine* station 17*a* "agreeing with the published figures." In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *lusitanica* was inserted in the key to the species of *Thalassometra*, and the synonymy and range were given. In my memoir on the crinoids of the *Ingolf* expedition published in 1923 *Stiremetra lusitanica* was included and the range was given. This information was repeated by Dr. Th. Mortensen in 1927 in his work on the echinoderms of the British Isles, and by Prof. Augusto Nobre in 1931 and 1938 in his book on the echinoderms of Portugal.

STIREMETRA BREVIRADIA (P. H. Carpenter)

[See vol. 1, pt. 1, figs. 486, 487, p. 365; pt. 2, pl. 2, figs. 975–978, pl. 44, fig. 1301.]

Antedon radiospina von Graff, Bull. Mus. Comp. Zool., vol. 11, No. 7, 1883, p. 133 (*nomen nudum; Challenger* station 170; myzostomes); *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 17, 19 (same); *Challenger* Reports, Narrative, vol. 1, pt. 1, 1885, p. 316 (same).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pl. 3, fig. 4, *a–c*.—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 491 (listed).

Antedon eversa P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pl. 3, fig. 5, *a–c*.—A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 471 (listed).

Antedon breviradia P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 110 (description; *Challenger* stations 170A, 175), pl. 3, figs. 4, *a–c*, 5, *a–c*; pl. 11, fig. 5, pl. 19, figs. 1–4, pl. 20, figs. 1, 2.—Walther, Einleitung in die Geol. als historische Wiss., 1894, p. 298 (after Carpenter).—Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (systematic and bathymetrical relationships).—Hutton, Index faunae Novae Zealandiae, 1904, p. 290 (listed).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (identity).

Thalassometra breviradia A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed).

Stiremetra breviradia A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 15 (listed); Crinoids of the Indian Ocean, 1912, p. 33 (identity), p. 211 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 45 (published references to specimens in the B. M.; *Challenger* stations 170A, 175); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 161 (in key; range; references).

Antedon variospina (Brit. Mus., MS.) A. H. Clark, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 45 (MS. name found with specimens from *Challenger* station 170A).

Diagnostic features.—The brachials beyond the proximal fourth of the arms have long, broad, curved, overlapping spines; the IBr series and lower brachials are smooth dorsally with straight sides, and with the median carination low and broad or obsolescent; and the cirri are arranged in 10 definite columns on the centrodorsal. The 10 arms are about 80 mm. long, and the cirri have 40–50+ segments.

Description.—The centrodorsal is hemispherical or rounded truncated conical with the dorsal pole bearing a number of papillae. The cirrus sockets are arranged in 10 columns of 2 or 3 each; the columns are in close contact interradially, but are separated in the midradial line by a V-shaped bare area of which the base, at the rim of the centrodorsal, is about as broad as the adjacent cirrus sockets and the apex lies between the second or third cirrus sockets from the base.

The cirri are XV–XX, 40–50+; the seventh–tenth segments are longer than broad and those following are shorter with a well marked dorsal spine.

The radials are scarcely visible. The IBr$_1$ are short and convex with occasional traces of a median ridge or keel, especially in young individuals. The IBr$_2$ (axillaries) are short and widely hexagonal, projecting proximally into the IBr$_1$; they may show a median low keel in the proximal two-thirds. The elements of the IBr series and first brachials have straight edges and flattened sides.

The 10 arms are probably about 80 mm. long. The proximal brachials are triangular or quadrate, rather longer than broad, and the distal are laterally compressed and overlapping so as to become carinate. The figures show the brachials in the outer two-thirds of the arms with long, carinate, and curved median overlapping spines. The inner faces of the second brachials and of the hypozygals of the first syzygial pair are slightly flattened.

Syzygies occur between brachials 3+4, again between the thirteenth and twenty-sixth brachials (usually about the sixteenth), and distally at intervals of from 2 to 16 (usually 4 or 5) muscular articulations.

P_1, which is much larger than P_2, consists of about 12 segments of which the first six are wide and thick with their outer sides somewhat flattened, and the third–fifth have their inner edges produced into expanded processes which are slightly folded upward. The next 3 or 4 pinnules on either side are quite small, and the length gradually increases, the later pinnules becoming styliform with elongated segments. On some arms the first two segments of the distal pinnules are rather expanded and trapezoidal, though on others they are not specially modified.

The disk is 6 mm. in diameter. The disk and the brachial ambulacra are well plated. The side- and covering-plates along the pinnule ambulacra are generally well differentiated. Sacculi are largely developed on some of the pinnules, though altogether absent on others.

The color in alcohol is light brownish white.

Notes.—The preceding description is adapted from Carpenter with additional information derived from his figures.

Carpenter said that in this species the IBr_1 are relatively longer than those of *S. lusitanica* and more distinctly incised by the axillaries, which are hexagonal rather than pentagonal as in that species, while in the younger individuals both elements of the IBr series show distinct indications of a median ridge like that which is so marked in *S. spinicirra* and *S. acutiradia.* He said that the characters of the cirri and of P_1 also separate *S. breviradia* from *S. lusitanica,* "which was probably without such distinctly carinate outer arm-joints as occur in *Antedon* [*Stiremetra*] *breviradia.*" He said that some of the later pinnules have the lower segments flattened and expanded as in *Aglaometra valida,* while in others there is but little trace of this peculiarity. There is a similar variation as regards the sacculi. On some pinnules they are abundant, alternating regularly with the side plates; on others there are very few; and some pinnules are altogether without them.

Carpenter remarked that the characters of the calyx undergo a considerable amount of change during development. The centrodorsal is deeper and more conical in the older individuals, in which the more numerous cirrus sockets are arranged in tolerably regular columns. There are two of these columns under each interradial angle of the calyx, each with 3 sockets which alternate with those of adjacent columns, and the dorsal pole is covered with a number of short stout processes of which there is but little trace in a younger individual. The two also differ in the characters of the radial pentagon. In the younger one its lower face is tolerably flat and smooth, with the rosette rather near the surface and little or no indication of a basal star, while in the older it is more deeply sunken within the axial opening and is surrounded by a fairly definite basal star. The surface of each radial is also very convex and rises to one or two sharp points near the middle of the distal edge. The lower part of the muscular fossae is occupied by two or three strongly marked ridges with intervening furrows which are altogether absent in less mature individuals. The latter, however, have the upper end of the muscle plates more everted than in the adults, so that the central opening of the calyx is relatively larger and more pentagonal in appearance.

Carpenter had no doubt that these were merely differences of growth, and that they are not of specific value as he had supposed when the plates were lettered. On plate 3 of the *Challenger* report a young individual, the centrodorsal and radial pentagon of which are shown in figures 5, *a–e*, is called *eversa*, and a full grown one, details of which are shown in figures 4, *a–c*, is called *radiospina*. In the explanation to the plate figures 4 and 5 are both given under the name *breviradia*.

It is possible that two species are confused under the name *breviradia*. The description is applicable to the form referred to by Carpenter as the older and called on plate 3 *radiospina*, which therefore becomes a synonym of *breviradia*. If the younger form should prove to be distinct the name *eversa*, occurring on plate 3, is available for it.

Localities.—Challenger station 170A; near the Kermadec Islands (lat. 29°45′ S., long. 178°11′ W.); 1,152 meters; bottom temperature 4.17° C.; volcanic mud; July 14, 1874 [von Graff, 1883, 1884, 1885; P. H. Carpenter, 1888; Walther, 1894; Hartlaub, 1895; Hutton, 1904; A. H. Clark, 1907, 1909, 1912, 1913, 1918] (3, B. M.).

Challenger station 175; near Kandavu, Fiji (lat. 19°02′ S., long. 177°10′ E.); 2,285 meters; bottom temperature 2.2° C.; globigerina ooze; August 12, 1874 [P. H. Carpenter, 1888; Walther, 1894; Hartlaub, 1895; Hutton, 1904; A. H. Clark, 1907, 1909, 1912, 1913, 1918] (1, B. M.).

Geographical range.—From Fiji southward to the Kermadec Islands northeast of New Zealand.

Bathymetrical range.—From 1,152 to 2,285 meters.

Thermal range.—From 2.2° to 4.17° C.

History.—This species was first mentioned by Prof. Ludwig von Graff who in 1883 recorded and described the myzostomes found with the specimens from *Challenger* station 170; in recording the host of these myzostomes Professor von Graff used the name *Antedon radiospina*. He used this name again in 1884 and in 1885. When I saw him at Graz in 1910 he told me that for the hosts of myzostomes he had accepted the names given him by Carpenter and had left to Carpenter the task of allocating the names in the synonymy. In the *Challenger* reports on the comatulids published in 1888 Carpenter gave a detailed account of this species under the name *Antedon breviradia*, in the text making no mention of any other names. In the explanation of the figures on plate 3 he listed figures 4 and 5 under *Antedon breviradia*, but at the bottom of the plate the species illustrated by figure 4 is given as *Antedon radiospina*, and that illustrated by figure 5 as *Antedon eversa*.

Walther in 1894, Hartlaub in 1895, and Hutton in 1904 mentioned *Antedon breviradia*, taking their information from the *Challenger* report.

In my first revision of the genus *Antedon* published in 1907 *breviradia* was referred to the new genus *Thalassometra*, and in 1909 I referred it to the new genus *Stiremetra*. In 1912 I listed it, with the synonymy and range, in my memoir on the crinoids of the Indian Ocean. In my paper on the crinoids of the British Museum published in 1913 I mentioned having seen four specimens from *Challenger* stations 175 and 170*a*, and that one of the specimens from station 170*a* bore the manuscript name *Antedon variospina.* In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *breviradia* was inserted in a key to the species of the genus *Stiremetra*, and the references and range were given.

STIREMETRA PERPLEXA (A. H. Clark)

PLATE 14, FIGURE 44

Thalassometra perplexa A. H. CLARK, Zool. Anz., vol. 39, No. 11/12, 1912, p. 426 (description; *Siboga* station 211).

Stiremetra perplexa A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 161 (in key; range; references; detailed description; station 211), p. 274 (listed), pl. 23, fig. 63.

Diagnostic features.—The axillaries are shield-shaped, very long, half again as long as broad, smooth, very sharply flattened laterally, the edges unmodified; the IBr_1 have the central portion of the dorsal surface recumbent, making an angle of approximately 90° with the dorsoventral axis, the edges smooth and unmodified; the brachials do not have overlapping spines; and the cirri are arranged in 10 definite columns on the centrodorsal. The cirri are 35–40 mm. long with 62–66 segments, and there are 10 arms.

Description.—The centrodorsal is small, truncated conical, with the dorsal pole entirely covered by elongate tubercles or papillae. The cirrus sockets are arranged in 10 closely crowded columns of 2 or 3 (usually 2) each.

The cirri are XVIII, 62–66, from 35 to 40 mm. long. The longest cirrus segment, usually the sixth, is from two and one-half to three times as long as broad. The segments following this slowly decrease in length, in the middle of the cirri being about as long as broad, or slightly broader than long, and in the terminal fourth or fifth twice as broad as long. The longer proximal segments have a slight median constriction and slightly produced distal edges. The short distal segments have a prominent median dorsal keel which, instead of being sharp along the crest, is broadly rounded. This keel begins as a production of the distal dorsal border of the segment, but soon involves the entire dorsal surface becoming, in profile view, rounded triangular, the apex near the distal end, then evenly rounded, and in the terminal portion more or less straight along the crest.

The ends of the basal rays are concealed.

The radials are concealed. The IBr_1 are very narrow and bandlike, abutting directly upon the centrodorsal though everywhere separated from it by narrow subradial clefts, from 6 to 8 times as broad as long. They are everywhere of the same length, but while the outer surface of their lateral portions is parallel to the axis of the IBr series, their median portion is recumbent, making an angle of nearly 90° with that axis so that in direct lateral view, that is, viewed at right angles to the dorsoventral axis, they are only about one-third as long in the middorsal line as laterally. The IBr_2 (axillaries) are rhombic with produced and broadly tuncated lateral angles, half again as long as broad; the lateral edges are about as long as those of the IBr_1; the distal sides are strongly concave; a posterior process, about as high as the anterior angle though somewhat broader and more rounded, incises the IBr_1; the proximal two-thirds of the median portion of the axillaries rises into a prominent, but well rounded, median elevation. The elements of the IBr series are very sharply flattened against their neighbors, this flattening persisting as far as the base of P_1.

The 10 arms are all broken off at the first syzygy. The first brachials are short, deeply incised by the second; their exterior length is much greater than the interior and more than twice the median, the distal border being strongly concave. The second brachials are irregularly quadrate with a strong posterior process incising the first; the proximal three-fourths of the median line is elevated as in the IBr_2. The third brachial (hypozygal of the first syzygial pair) is oblong, very short, about five times as broad as long.

P_1 is 5.5 mm. long with 19 segments of which the first eight are much larger, though proportionately shorter, than those succeeding; the second-seventh have thin, very high, carinate processes that reach a maximum on the fourth, thence rapidly decreasing in height distally. After the eighth segment the pinnule is relatively slender and tapers gradually to the tip. In lateral view the pinnule appears enormously swollen in the proximal three-fifths (first eight segments), the swelling reaching a maximum on the fourth segment and decreasing rapidly distally; beyond the eighth segment the pinnule is slender and evenly tapering, composed of segments most of which are about as long as broad, with numerous spinules along the prismatic ridge.

Locality.—*Siboga* station 211; southeast of Sindjai, Celebes (lat. 5°40′42″ S., long. 120°45′30″ E.); 1,158 meters; coarse gray mud, the superficial layer more fluid and brown; September 25, 1899 [A. H. Clark, 1912, 1918] (1, Amsterdam Mus.).

History.—This species is known only from the single specimen originally described in 1912 and redescribed and figured in 1918.

STIREMETRA CARINIFERA A. H. Clark

[See vol. 1, pt. 1, fig. 97, p. 159.]

Stiremetra carinifera A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 211 (description; *Investigator* station 232); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 161 (in key; range; references).

Diagnostic features.—The IBr_1 have the proximal and distal edges prominently everted, smooth, somewhat wavy, or coarsely tubercular, and a prominent median rounded carination; the brachials do not bear overlapping spines; and the cirri are arranged in 10 definite columns on the centrodorsal. There are 10 arms, and the cirri are 45–50 mm. long with 50–64 segments.

Description.—The centrodorsal is large and columnar with the sides practically parallel, 5 mm. in diameter at the base and 3.5 mm. high interradially. The cirrus sockets are arranged in 10 columns, 3 or 4 sockets to a column, the columns segregated into five interradial pairs. The two columns of each pair are separated by a narrow ridge of moderate height; in the midradial line the pairs of columns are separated by deep V-shaped furrows as broad as the adjacent cirrus sockets; the central groove of these furrows is slightly rounded. The dorsal pole of the centrodorsal is flattened, with the surface more or less irregular

The cirri are XXXV, 50–64 (usually 57 or 58), from 45 to 50 mm. long. The first segment is very short, those following gradually increasing in length and becoming about as long as broad on the fifth and nearly or quite twice as long as broad on the eighth (more rarely seventh), which is a transition segment. The following segments gradually decrease in length, becoming about as long as broad on the twelfth or thirteenth, and after the twenty-fifth about twice as broad as long. On the second segment beyond the transition segment prominent median terminal spines begin to appear; these gradually come to involve more and more of the dorsal surface of the segments, which becomes carinate, so that after the twenty-third the dorsal profile is straight and parallel to the longitudinal axis of the cirrus as a whole. In the next four to seven segments a shallow rounded notch is developed in this straight dorsal profile so that the segments appear to have both a proximal and a distal spine. Beyond this point the dorsal processes are of the high strongly carinate type common to the other species of the genus.

The ends of the basal rays are visible in the interradial angles of the calyx just over the ends of the ridges separating the individual columns of cirrus sockets in the interradial pairs; they appear as small dorsoventrally elongated tubercles.

The radials are almost entirely concealed. They bear on their apposed edges, just over the ends of the basal rays, two tubercles or blunt spines, one on each radial. Owing to the depth of the midradial furrows on the centrodorsal the subradial clefts are practically obsolete, only their inner ends being visible as very narrow and very shallow grooves. The IBr_1 are extremely short, six or more times as broad as long, chevron-shaped, with both the anterior and posterior edges prominently everted and smooth, somewhat wavy, or coarsely tubercular; in the middorsal line there is a prominent median rounded carination.

The IBr_2 (axillaries) and arms are lacking.

Notes.—A smaller specimen found with the type appears to represent a younger stage of the same species. The centrodorsal is truncated conical, 3.5 mm. in diameter at the base and 1.5 mm. broad at the dorsal pole; the height is 3 mm. measured along the inclination of the sides. The dorsal pole is covered with short spines. In general the centrodorsal resembles that of the other specimen, but owing to its conical shape the midradial furrows converge distally.

The cirri are about 40 mm. long and are composed of 54–58 segments of which the sixth is a transition segment.

The ends of the basal rays are rather more prominent than they are in the other specimen.

The radials are smooth, without lateral spines. The IBr_1 have scarcely a trace of the eversion of their edges, but possess a higher and sharper median keel, and usually also a sharp tubercle on the distal border about one-third the distance between the distal lateral angle and the median line. The IBr_2 (axillaries), which are missing in the other specimen, are approximately triangular (though probably shield-shaped as in other species of the genus when fully grown), twice as broad as long, with a high and sharp carination in the proximal two-thirds of the median line and with everted and spinous distal edges.

On one of the postradial series the IBr_2 is not axillary as usual but bears a pinnule which is essentially similar to P_1 in related species; the second segment beyond this is axillary; there is no carination beyond the first pinnule. Only two axillaries are preserved, both detached. One has lost both derivatives at the first postaxillary articulation; the other bears on one side one and on the other side three brachials.

Locality.—*Investigator* station 232; Laccadive Sea (lat. 7°17′30″ N., long. 76°54′30″ E.); 786 meters; (A. H. Clark, 1912, 1918] (2, U.S.N.M., 35593; I. M.).

History.—This species was originally described in my memoir on the crinoids of the Indian Ocean published in 1912. I said that it appears to be a very distinct species. The large cirri with numerous segments resemble those of *Daidalometra arachnoides*, but the centrodorsal is very much larger and the columns of cirrus sockets are segregated into widely separated pairs instead of being closely crowded. The ossicles of the calyx and arm bases also lack the spinous edges and the high median carinate processes so characteristic of that form. The small centrodorsal of *S. spinicirra*, which is hemispherical or bluntly conical with no differentiation into areas, as well as the short cirri with few segments, each of which bears a spine, serves to differentiate that species. *Stiremetra acutiradia* also has a small centrodorsal with only about 15 cirrus sockets which are differently arranged. *Stiremetra breviradia* has cirri with 40–50 segments, "or a few more," but the centrodorsal is of the type found in *D. arachnoides*, quite different from that in the species under consideration. It is probable, however, that this is the species to which *S. carinifera* is most closely allied.

In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *carinifera* was inserted in the key to the species of *Stiremetra* and the original reference was given.

STIREMETRA ACUTIRADIA (P. H. Carpenter)

Antedon acutiradia P. H. Carpenter, Quart. Journ. Micr. Sci., vol. 27, 1887, pp. 386, 387 (sacculi present between the side plates; *nomen nudum*); *Challenger* Reports, Zool., vol. 26, pt. 60, 1888, p. 113 (description; *Challenger* station 175), pl. 11, figs. 3, 4.—Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (systematic and bathymetrical relationships).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (of P. H. Carpenter, 1888=*Stiremetra acutiradia*).

Thalassometra acutiradia A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed).

Stiremetra acutiradia A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 15 (listed); Crinoids of the Indian Ocean, 1912, p. 33 (identity), p. 211 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 45 (published references to specimens in the B. M.; *Challenger* Station 175); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 161 (in key; range; references).

Diagnostic features.—The axillaries are long, longer than broad; the IBr series and proximal brachials have a smooth dorsal surface, straight sharp edges, and a sharp median keel; the first four brachials do not bear dorsal spines; and the cirri are arranged in 10 definite columns on the centrodorsal. The 10 arms are probably about 50 mm. long.

Description.—The centrodorsal is a somewhat elongated hemisphere with a papillose dorsal pole. According to the figure the cirrus sockets are arranged in a single rather crowded marginal row, two sockets in each radial area; the radial areas are not specially differentiated.

The cirri, according to the description, are about XV; the fourth and some of the following segments are much longer than broad with traces of dorsal spines.

The radials are just visible beyond the rim of the centrodorsal. The IBr_1 are partly free laterally and are deeply incised by the sharp proximal angles of the IBr_2 (axillaries), which are longer than broad. Both ossicles are very sharply convex and almost carinate, but the IBr_2 are broader and have a more rounded surface than the IBr_1, which are partly hidden beneath their lateral angles. The elements of the IBr series and first brachials have straight edges and flattened sides. The inner side of the second brachial and the hypozygal of the first syzygial pair are also flattened.

The 10 arms are about 50 mm. long. The first brachials are somewhat incised for the sharp proximal angles of the second (there is considerable variation in this respect), both ossicles rising to their line of junction. The sixth and following brachials are smooth and obliquely triangular, much longer than broad, the later ones becoming obliquely quadrate.

Syzygies occur between brachials 3+4, again between brachials 17+18, and distally at intervals of 4 or 5 muscular articulations.

P_1 is much larger than P_2 with wide and thick lower segments which have somewhat flattened outer sides; the third–fifth segments have their inner edge produced into an expanded process which is slightly folded upward. P_a and P_2 are rather larger than their immediate successors, but those following are quite small and increase very slowly in length.

The disk is 4 mm. in diameter and is well plated. The brachial ambulacra are slightly plated. The pinnule ambulacra are without very definite side plates. The presence of sacculi is uncertain.

The color in alcohol is light brownish white.

Notes.—The preceding description is adapted from Carpenter's original description, with a few additions from the published figure. Carpenter said that this species is unfortunately represented only by two calices and half a dozen arm fragments with their pinnules mostly broken. The IBr_1 are much compressed laterally so that they appear as it were at a lower level than the axillaries the lateral angles of which overlap and partly conceal them. The state of preservation of the pinnules in the two individuals is unfortunately such that it is impossible to speak positively respecting the presence or absence of sacculi. But there was no trace of them in any of the few pinnules Carpenter was able to examine. No entire cirri are preserved, and Carpenter wrote that the position to which he assigned this species among those with from 30 to 50 spiny cirrus segments is therefore a somewhat conjectural one. He said that it has so many points of resemblance with *spinicirra*, *breviradia*, and *lusitanica* that he had little doubt respecting the character of its cirri.

Carpenter said that this species is most nearly related to *S. spinicirra* from which it differs in the sharper carination and greater relative length of the axillaries.

I examined one of Carpenter's specimens during a visit to the British Museum in 1910. It is a small and delicate species and was well figured by Carpenter.

Locality.—*Challenger* station 175; near Kandavu, Fiji (lat. 19°02′ S., long. 177°10′ E.); 2,468 meters; bottom temprature 2.2° C.; globigerina ooze; August 12, 1874 [P. H. Carpenter, 1887, 1888; Hartlaub, 1895; A. H. Clark, 1907, 1909, 1912, 1913, 1918] (1, B. M.).

History.—This species was first mentioned as *Antedon acutiradia* by Dr. P. H. Carpenter in 1887, when he said that sacculi are present between the side plates in this species. The name as it appears here is a *nomen nudum*.

In the *Challenger* report upon the comatulids published in 1888 Carpenter described and figured *Antedon acutiradia* on the basis of two calices and half a dozen arm fragments from *Challenger* station 175. In the description he said that the presence of sacculi was uncertain and that there is no trace of them in any of the few pinnules he had been able to examine. Dr. Clemens Hartlaub discussed the systematic and bathymetrical relationships of *Antedon acutiradia* in 1895.

In my first revision of the genus *Antedon* published in 1907 *acutiradia* was placed in the new genus *Thalassometra*, and in my revision of the family Thalassometridae published in 1909 it was made the type of the new genus *Stiremetra*. In my memoir on the crinoids of the Indian Ocean published in 1912 *Stiremetra acutiradia* was listed and the synonymy and range were given. In a paper on the crinoids of the British Museum published in 1913 I published a short note on one of Carpenter's original specimens which I had examined at the British Museum in the summer of 1910. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *acutiradia* was included in the key to the species of the genus *Stiremetra* and the synonymy and range were given.

STIREMETRA DECORA, sp. nov.

PLATE 5, FIGURE 18

Thalassometra crassicirra (part) A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 225 (small 10-armed specimen from *Albatross* station 4107).

Cosmiometra crassicirra (part) A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 17; Vid. Medd. Naturh. Foren København, 1909, p. 186; Crinoids of the Indian Ocean, 1912, p. 215; Unstalked crinoids of the *Siboga*-Exped., 1918, p. 154.

Stiremetra decora A. H. CLARK, Bernice P. Bishop Mus. Bull. 195, 1949, p. 74 (*nomen nudum*, *Albatross* station 4107), p. 110 (station data).

Diagnostic features.—The axillaries are short, nearly or quite twice as broad as long, with a high median carination that may be more or less deeply notched in the middle; the IBr_1 have two long and rather stout blunt spines, one on the distal edge and one near the proximal edge, and a similar but shorter spine on each side; the brachials do not bear dorsal spines; and the cirri, in which the first four segments do not bear dorsal spines, are arranged in 10 definite columns on the centrodorsal. The 10 arms are probably about 50 mm. long, and the cirri have 30–40 segments.

Description.—The centrodorsal is conical, about as high as broad at the base with a truncated tip which bears several prominent papillae. The surface of the centrodorsal is not differentiated, the cirrus sockets being arranged in 10 crowded columns of 2 or 3 each.

The cirri are about XX, with between 30 and 40 segments of which about the fourth is a transition segment. The transition and next following segments are nearly twice as long as broad, and the segments in the outer half of the cirri are about half again as broad as long. The short outer segments bear very high and prominent, rather narrow, curved dorsal spines.

The ends of the basal rays are visible in the angles of the calyx.

The radials project slightly beyond the rim of the centrodorsal in the midradial line; their distal border is strongly curved so that they extend well upward in the interradial angles. The distal edge is turned outward and the dorsal surface is curved so that, viewed laterally, the radials are seen to curve outward above the rim of the centrodorsal. In the middle of the dorsal surface of the radials there is a very high transversely broadened oblong or more or less fan-shaped process with a serrate tip. This process, which rises abruptly, is about as high as the middorsal length of the radials. The IBr_1 are about twice as broad as long, somewhat broader proximally than distally, very strongly rounded dorsally, with the proximal and distal borders slightly produced. In the median line they bear two long and rather stout blunt spines, one on the distal edge and the other below it near the proximal edge, the distal being somewhat the stouter and longer. There is a similar but shorter spine on each side near the anterolateral angle. The IBr_2 (axillaries) are rhombic, nearly or quite twice as broad as long, with the lateral angles extending considerably beyond the anterolateral angles of the IBr_1. The two anterior sides are everted and bear a group of short spines or serrations near the apex between them. In the proximal two-thirds of the middorsal line there is a high narrow crest which may be more or less deeply notched in the middle so as to form two points, of which the distal is the higher and sharper.

The 10 arms were probably about 50 mm. long. The first brachials are somewhat more than three times as broad as the median length, slightly longer exteriorly than interiorly, with the proximal and distal edges straight and nearly parallel; the borders are slightly and narrowly swollen and the inner sides are in apposition for their entire length. A high spine, sometimes laterally broadened, rises abruptly from the middle of the distal border. The second brachials are larger than the first, irregularly quadrate with the proximal border extended downward as a rather long broadly rounded process the inner side of which runs distally at an angle of about 45° so that the inner edges of the second brachials meet considerably above the anterolateral angles of the first brachials forming a conspicuous water pore. The borders of the second brachials are slightly thickened or everted and the middorsal line bears a narrow but distinct carination which may be produced into a short point at the anterior end, or at both ends. The first syzygial pair (composed of brachials 3+4) is about one-third again as long as broad, with the hypozygal and epizygal of equal length; both have a faintly indicated middorsal carination which on the epizygal may be produced into a point at the distal end. The next two brachials are oblong, about half again as broad as long, and those following soon become very obliquely wedge-shaped and about as long as broad, and distally elongate. The first two brachials following the first syzygial pair may be somewhat abruptly convex in the middorsal line, but those following are evenly rounded dorsally with smooth distal edges which are not produced.

Syzygies occur between brachials 3+4, 14+15, and 18+19, and distally at intervals of 3 or 4 muscular articulations.

P_1 is 4.5 mm. long with 11 segments, much longer and stouter than the following pinnules, stout at the base and tapering to a fine tip. The first three segments are about as long as broad and those following gradually become elongated and twice as long as broad terminally. A high and sharp ridge runs along the distal border of the outer face. P_2 is 2.5 mm. long with 7 segments, more slender than P_1 and tapering more gradually; the first two segments are about as long as broad and the terminal are half again as long as broad. The following pinnules resemble P_2. The distal pinnules are 4.5 mm. long with about 15–18 segments of which the first is broader than long, the second is about as long as broad, and those following are mostly about twice as long as broad. The distal pinnules are much compressed with a sharp carinate ridge running along the outer side, the ridge on each segment ending in a tuft of spinules.

Locality.—Albatross station 4107; Hawaiian Islands; Lae-o Ka Laau Light, Molokai Island, bearing S. 34°30′ E., 12.3 miles distant; 640–649 meters; coral, sand, and foraminifera; bottom temperature 5.33° C.; July 24, 1902 [A. H. Clark, 1908, 1909, 1912, 1918, 1949] (1, U.S.N.M., 36079).

History.—The type specimen of this species from *Albatross* station 4107 was recorded in 1908 as a "small ten-armed specimen" of *Thalassometra* (*Cosmiometra*) *crassicirra*. It is included under the name *Cosmiometra crassicirra* in the references to that species published in 1909, 1912, and 1918. Just why this highly distinctive and utterly different species should have been regarded as the young of *Cosmiometra crassicirra* is not clear.

STIREMETRA SPINICIRRA (P. H. Carpenter)

Antedon spinicirra P. H. Carpenter, *Challenger* Reports, Zool., vol. 26, pt. 60, 1888, p. 112 (description; *Challenger* station 164), pl. 11, figs. 1, 2.—Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (systematic and bathymetrical relationships).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (identity).

Thalassometra spinicirra A. H. Clark, Smithsonion Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed).

Stiremetra spinicirra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 15 (listed); Mem. Australian Mus., vol. 4, 1911, p. 795 (locality); Crinoids of the Indian Ocean, 1912, p. 33 (identity), p. 210 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 44 (published references to specimens in the B. M.; *Challenger* station 164); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 160 (in key; range), p. 161 (references).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 7, No. 28 (notes).

Diagnostic features.—All the cirrus segments except one or two of the basal bear high, broad, and conspicuous dorsal spines; a few of the earlier cirrus segments are slightly longer than broad; the axillaries are short, much broader than long; the IBr series and lower brachials have a smooth dorsal surface, a prominent rounded median carination, straight edges, and flattened sides; the brachials bear moderate overlapping carinated spines; and the cirri are arranged in 10 indistinct columns on the centrodorsal. The arms are about 45 mm. long, and the cirri are about 17 mm. long with 40–45 segments.

Description.—The centrodorsal is hemispherical or bluntly conical; judging from the figure the cirrus sockets are arranged in 10 columns of 2 each, and the surface of the centrodorsal is unmodified.

The cirri are XX–XXV, 40–45, according to the figure about 17 mm. long; 4 or 5 of the basal segments are slightly longer than broad, the remainder being broader than long, those in the distal half twice as broad as long; all but the basal segments (in the figure all but the first) bear a high, conspicuous, and sharp dorsal spine.

The radials are just visible beyond the centrodorsal. The IBr_1 and IBr_2 (axillaries) are sharply convex and almost carinate; the figure shows both with a moderately high carination having a longitudinally straight and transversely sharply rounded crest. The IBr_1 are partly free laterally and are but little incised by the hexagonal axillaries, which are much broader than long with a more rounded dorsal surface, though extending only slightly beyond the distal angles of the IBr_1. Both the elements of the IBr series and the first brachials have straight edges and sharply flattened sides. The inner sides of the second brachials and of the hypozygals of the first syzygial pair are likewise slightly flattened.

The 10 arms are probably about 45 mm. long. The second brachials are relatively short and oblong, not projecting much backward into the first, though both are sharply convex at their line of juncture. The next few brachials are about as long as broad, and those following are obliquely quadrate, longer than broad. The later brachials overlap slightly and become somewhat sharply carinate.

Syzygies occur between brachials 3+4, again between brachials 14+15, and distally at intervals of 3 or 4 muscular articulations.

P_1 is larger than P_2; its lower segments are relatively stout with somewhat flattened outer sides, and the inner edges of the third to the fifth segments are slightly carinate. P_a and P_2 are small, and those following increase slowly in length, the later ones sometimes showing a faint expansion of the two basal segments.

The color in alcohol is light brownish white.

Notes.—The preceding description is adapted from the original description by Carpenter, to which are added a few notes taken from his figure. I examined three of the five original specimens in London in 1910. This is a curious small and delicate species, with curiously long cirrus spines.

Prof. Torsten Gislén examined these specimens in August 1925. He noted that the synarthrial pairs are triangular and carinate and slender; the arms are otherwise smooth and in rather close lateral contact. He remarked that in my key to the genera of the subfamily Thalassometrinae (that is, the family Thalassometridae as now understood) published in the *Siboga* report the section referring to *Stiremetra* should be altered to "arms distally of Br 2 [the second brachial] without carination."

Locality.—*Challenger* station 164; near Sydney, New South Wales (lat. 34°08′ S., long. 152°00′ E.); 1,737 meters; bottom temperature 2.28° C.; green mud; June 12, 1874 [P. H. Carpenter, 1888; Hartlaub, 1895; A. H. Clark, 1907, 1909, 1911, 1912, 1913, 1918; Gislén, 1928] (3, B. M.).

History.—This species was first described by Dr. P. H. Carpenter in 1888 under the name of *Antedon spinicirra* from five specimens, two of which were much mutilated, that had been dredged by the *Challenger* at station 164 off Sydney, New South Wales. In 1895 Dr. Clemens Hartlaub discussed its systematic and bathymetrical relationships.

In my first revision of the genus *Antedon* published in 1907 *spinicirra* was assigned to the new genus *Thalassometra*, and in my revision of the family Thalassometridae published in 1909 it was transferred to the new genus *Stiremetra*. In my memoir on the Recent crinoids of Australia published in 1911 I listed it as one of the species known from the waters about Australia, and in my memoir on the crinoids of the Indian Ocean published in 1912 I listed it and gave the range. In a paper on the crinoids of the British Museum published in 1913 I gave a short note on the three specimens I had examined during a visit to that institution in 1910. In my report upon the unstalked crinoids of the *Siboga* expedition published in 1918 I again listed it and gave its range.

In 1928 Prof. Torsten Gislén published additional notes on the type specimens in the British Museum he had examined in 1925.

Genus OCEANOMETRA A. H. Clark

Thalassometra (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 214.

Crotalometra (part) A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, pp. 406, 642.

Oceanometra A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 606 (diagnosis; genotype *Thalassometra gigantea* A. H. Clark, 1908; range; included species); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 146 (in key; range), p. 150 (key to the included species).—Gislén, Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 22.

Diagnosis.—A genus of Thalassometridae in which the arms are rounded dorsally to the tips; there is no appreciable expansion of the proximal segments of the genital pinnules; the cirri are recurved distally, the outer segments with dorsal carinate spines; the arms are 17–28 in number, the division series and arm bases beset with spines, at least along their edges; and one or both of the elements of the pairs in the division series and first two brachials bear a median carinate process. The arms are 110–180 mm. long, and the cirri are 40–85 mm. long with 48–79 segments.

Geographical range.—From Timor and the Kei Islands to the Philippines and Hawaiian Islands.

Bathymetrical range.—From 55 to 786 (?872) meters.

Thermal range.—From 4.4° to 12.4° C.

Remarks.—The species of *Oceanometra* are closely related to those of the genus *Thalassometra*, from which they differ only in the greater number of arms; in the occurrence of keels on one or both the elements of the pairs of ossicles in the division series and first two brachials; and in having P_2 intermediate in character between P_1 and P_3 instead of small and similar to the following pinnules. For the most part they are larger and stouter than the species of *Thalassometra*, though one of the latter, *Th. agassizii*, is of equal size. Only one species, *O. annandalei*, is known from any considerable number of specimens; of the other two, *O. gigantea* is known only from the type specimen, and *O. magna* from the type specimen and one other.

History.—The first known species of this genus was described under the name of *Thalassometra gigantea* in 1908. In 1909 a young individual of *O. annandalei* from *Albatross* station 5116 was recorded under the name of *Crotalometra eupedata*; later in the same year *Crotalometra annandalei* was described. In 1912 a third species was described under the name of *Thalassometra magna.*

The genus *Oceanometra* was diagnosed in 1916 with the genotype *Thalassometra gigantea* A. H. Clark, the other species assigned to the genus being listed as *Oceanomtra magna* and *O. annandalei.* The status of the genus has since remained unchanged.

KEY TO THE SPECIES IN THE GENUS OCEANOMETRA

a^1. The second (but not the first) element in the pairs of ossicles in the division series, and the second (but not the first) brachials, bear a high sharp median keel; 17 arms 180 mm. long; cirri stout, 75 mm. long with 48–62 (usually 55–60) segments (Hawaiian Islands; 786–872 meters). **gigantea** (p. 139)

a^2. The first as well as the second element in the pairs of ossicles in the division series, and both the first and second brachials, bear median keels.

b^1. No spines on the dorsal surface of the proximal ossicles except along the borders and the crest of the keels; ossicles of the division series with irregularly dentate produced lateral borders; dorsal surface of earlier brachials sparsely spinous; 21–28 arms 120–175 mm. long; cirri large and stout, 60–85 mm. long with 63–74 segments (Arafura Sea to western Timor; 204–305 meters)--**magna** (p. 142)

b^2. Dorsal surface of proximal ossicles spinous; ossicles of the division series with smooth lateral borders which are not produced; dorsal surface of earlier brachials more or less densely spinous; 19–23 arms 110–160 (usually 110–130) mm. long; cirri more slender, 40–65 mm. long with 62–79 segments (Philippines and Malay Archipelago; 55–510 meters)---**annandalei** (p. 144)

OCEANOMETRA GIGANTEA (A. H. Clark)

Plate 14, Figure 41

[See also vol. 1, pt. 1, figs. 203, p. 239, 364, p. 297; pt. 2, figs. 145, 146, p. 83, 220, p. 168, 284, p. 255, 322, 332, p. 227, 344, p. 229, 859–866, p. 419.]

Thalassometra gigantea A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 214 (in key), p. 222 (description; *Albatross* station 3985); vol. 35, 1908, p. 121 (proximal ornamentation; arm structure); Amer. Nat., vol. 42, No. 500, 1908, p. 542 (belongs to a group characteristic of the oceanic area); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (same); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14 (listed); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 551 (nearest to *Th.* [*Oceanometra*] *annandalei*); Zool. Anz., vol. 39, No. 11/12, 1912, pp. 425, 426 (compared with *Th.* [*Oceanometra magna*); Crinoids of the Indian Ocean, 1912, p. 203 (synonymy; locality); Die Crinoïden der Antarktis, 1915, p. 124 (shows the characteristic features of *Anthometra adriani*).

Oceanometra gigantea A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 606 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. ix (relationship with *O. magna*), p. 150 (in key; range), p. 151 (references).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser, vol. 45, No. 11, 1934, p. 27.—A. H. Clark, Bernice P. Bishop Mus. Bull. 195, 1949, p. 74 (*Albatross* station 3985), p. 99 (station data).

Diagnostic features.—The second, but not the first, element in the pairs of ossicles in the division series, and the second, but not the first, brachials bear a high sharp median keel. This is a large and stout species with 17 arms 180 mm. long, and the stout cirri 75 mm. long with 48–62 (usually 55–60) segments.

Description.—The centrodorsal is a truncated cone 10 mm. broad at the base, 10 mm. high, and 3 mm. across the broad and flat dorsal pole. Its surface is divided into 5 radial areas by 5 narrow, but high, interradial ridges. The cirrus sockets are arranged in 2 columns of about 4 each in each radial area, the 2 columns in each radial area being separated by a bare area which in width is equal to about three-quarters the transverse diameter of the sockets, or twice the width of the interradial ridges. The bare areas in the midradial line between the columns of cirrus sockets, the interradial areas, and the distal half of the centrodorsal, which bears no cirri, have a rough and uneven surface and are thickly covered with small spines.

The cirri are XL, 48–62 (most commonly 55–60), 75 mm. in length. The first segment is very short and those following gradually increase in length so that the fifth is about as long as broad and the ninth is about twice as long as its proximal width. The tenth segment is about half again as long as broad and those succeeding slowly decrease in length, the sixteenth and seventeenth being about as long as broad, the distal broader than long, and the terminal about twice as broad as long. The basal segments are broad in lateral view, but after the sixth they decrease rather rapidly in width. The ninth segment is broader proximally than distally; its distal end is encircled by a narrow band with a polished surface resembling that of the succeeding segments, the remainder of the surface being dull like that of the segments preceding. The tenth and following segments are laterally compressed. After the eleventh or twelfth a dorsal keel begins to develop which soon becomes high and gradually takes the form of carinate dorsal spines with a long dorsal crest which is parallel to the axis of the segments, the dorsal crest becoming shorter and the processes more spinelike as the segments decrease in length. The opposing spine is triangular, arising from nearly the whole of the dorsal surface of the penultimate segment, and short, not reaching half the width of the penultimate segment in height. The terminal claw is about as long as the penultimate segment or rather shorter, stout, and moderately curved. In the shorter more distally situated cirri, which have usually less than 55 segments, the transition segment may be the eighth or even the seventh instead of the ninth as is most commonly the case in the longer cirri.

The disk is scantily plated, even along the ambulacral grooves, but the brachial and pinnule ambulacra are well plated. The integument along the ambulacral grooves and the entire integument of the ventral surface of the arms is raised into very numerous small papillae which give it a very characteristic appearance.

The ends of the basal rays are visible as tufts of branching spines in the interradial angles of the calyx.

There is a deep but narrow, almost triangular, cleft between the centrodorsal and the radials which is bounded on either side by the proximal cirrus sockets of each column.

The radials scarcely extend beyond the rim of the centrodorsal; their distal edges are bordered with a row of long papillae or branching spines. The IBr_1 are short, three or four times as broad as long, with the proximal border convex so that they are longer in the median line than laterally. The proximal and distal edges are somewhat everted and are fringed with branching spines. The IBr_2 (axillaries) are low triangular, about twice as broad as long, with a high sharp median keel in the proximal two-thirds; the borders are everted and fringed with spines, the median keel bears a row of spines along its crest, and there are a few spines scattered over the dorsal surface. IIBr series are present on 3 of the postradial series: 5 of these are 4(3+4) and the sixth is 2. The IIBr series resemble the IBr series. Where the IIBr series are 2 the axillary has a tall sharp median keel like that on the IBr axillary, but the $IIBr_1$ is quite without a trace of one. Where the IIBr series are 4(3+4) both the second and fourth elements have similar keels, but the first and third are without them. One of the IIBr series bears a IIIBr series of 2, developed interiorly. The division series and lower brachials are well rounded dorsally and, though usually just in apposition laterally, are not laterally flattened.

The 17 arms of the type specimen are 180 mm. long and stout. The first brachials are wedge-shaped, rather longer exteriorly than interiorly, with the edges everted and spinous and the dorsal surface evenly rounded. The second brachials are wedge-shaped, also rather longer exteriorly than interiorly, with the edges everted and spinous, and with a high narrow sharp median keel like that on the axillaries preceding. The following 8 brachials are oblong, rather more than twice as broad a long, with the edges everted and spinous and the dorsal surface thickly covered with small sharp papillae. The succeeding brachials are triangular, about as long as broad, with both the proximal and distal edges, but especially the distal, strongly everted and finely spinous, and the dorsal surface roughened. Distally the brachials become wedge-shaped again, then elongate. On the earlier triangular brachials the eversion of the proximal edges gradually becomes obsolete, while that of the distal edges becomes directed forward, forming a strongly overlapping distal border, and develops longer and more numerous spines. On the succeeding wedge-shaped brachials the distal edges are strongly overlapping and are fringed with rather long spines, while the dorsal surface is covered with longitudinal rows of distally directed spines.

Syzygies occur between brachials 3+4, again from between brachials 16+17 to between brachials 19+20 (in 1 case also between brachials 5+6), and distally at intervals of about 12 or 14, decreasing later to 6 or 9, muscular articulations.

P_1 is 18 mm. long, stouter than P_2 though not markedly so, tapering evenly from the base to the tip; it is composed of 25 segments which are all about twice as long as broad, sharply carinate dorsally, and also produced ventrally into a rounded carination. P_D is similar to P_1. P_2 is 10 mm. long, much less stout than P_1, tapering evenly from the base to the tip, with 15 segments of which the first 4 are broader than long and those following are about as long as broad, gradually becoming longer than broad. The segments have a spinous dorsal carination which is more or less overlapping, and their ventral distal angles are produced so as to give the ventral profile a strongly serrate appearance. The following pinnules are similar but gradually decrease in length, P_5 being 7 mm. long and the 2 succeeding of about the same size, then gradually increase again, the component segments at the same time becoming smoother and more regular. The distal pinnules are 15 mm. long with 20 segments of which the first is short and crescentic, the second is trapezoidal, not so long as broad at the base, and the remainder are about half again as long as broad, becoming about twice as long as broad distally. The distal pinnules are strongly prismatic, the prismatic ridge bearing a narrow line of fine spines.

Locality.—*Albatross* station 3985; Hawaiian Islands, off Kaui; Hanamaulu warehouse bearing S. 53°30′ W., 6 miles distant; 786–872 meters; bottom temperature 4.4° C.; gray sand, Foraminifera, and shore deposit; June 10, 1902 [A. H. Clark, 1908, 1909, 1911, 1912, 1915, 1916, 1918, 1949; Gislén, 1934] (1, U.S.N.M., 22687).

History.—*Thalassometra gigantea* was described in 1908 from a single specimen from *Albatross* station 3985; later in the same year its proximal arm structure was described in detail and explained (see Part 2, page 105, and figures 145, 146, page 83). In two other papers published in the same year this species was said to belong to a group characteristic of the oceanic areas. In my revision of the family Thalassometridae published in 1909 *gigantea* was listed as a species of *Thalassometra*. In 1911 *Thalassometra annandalei*, originally described in the genus *Crotalometra*, was transferred to *Thalassometra* in which genus it was said to occupy a position near *Th. gigantea*, and in 1912 *Th. gigantea* was compared with *Th. magna*, sp. nov. In my memoir on the crinoids of the Indian Ocean published in 1912 *Thalassometra gigantea* was listed and the synonymy and range were given. In my memoir on the crinoids of the Antarctic published in 1915 the ornamentation of this species was compared with that of *Anthometra adriani*. In 1916 *Thalassometra gigantea* was made the type of the new genus *Oceanometra*. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *Oceanometra gigantea* was listed, and the synonymy and range were given. Its relationship to *O. magna* was discussed. In 1934 Prof. Torsten Gislén discussed the arm structure of this species.

OCEANOMETRA MAGNA (A. H. Clark)

Plate 14, Figures 42, 43

[See also vol. 1, pt. 2, fig. 221, p. 171.]

Thalassometra magna A. H. Clark, Zool. Anz., vol. 39, No. 11/12, 1912, p. 425 (description; *Siboga* station 251).

Oceanometra magna A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 606 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. ix (relationship with *O. gigantea*), p. 151 (in key; range; detailed description; sta. 251), p. 274 (listed), pl. 22, fig. 57; Ann. Mag. Nat. Hist., ser. 10, vol. 10, No. 58, October 1932, p. 378 (history; listed), p. 382 (south of western Timor; 140–160 fathoms; notes), pl. 14.—Gislén, Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 27, 28.

Diagnostic features.—All the ossicles of the division series and both the first and second brachials bear median keels; no spines on the ossicles of the division series and first two brachials except along the edges and on the crest of the keels; ossicles of the division series with irregularly dentate produced lateral borders; dorsal surface of earlier brachials sparsely spinous. A stout species with 21–28 arms 120–175 mm. long, and the large and stout cirri 60–85 mm. long with 63–74 segments.

Description.—The centrodorsal is conical with the tip truncated, 5.5 mm. broad at the base and 5.0 mm. high; the dorsal pole is about 1.5 mm. in diameter, approximately flat and covered with fine papillae. The cirrus sockets are arranged in 10 columns of usually four each, the two columns of each radial area being in close contact with those of adjacent radial areas exteriorly, but separated in the midradial region by a bare slightly concave area which is proximally nearly or quite as broad as the adjacent cirrus sockets.

The cirri are XXX–XL, 66–74, from 70–85 mm. long; the longest cirrus segments are nearly or quite twice as long as broad.

The ends of the basal rays are visible as dorsoventrally elongate tubercles bridging over the very deep but very narrow subradial clefts.

The radials are very short with a slight rounded median prominence and with a few small teeth on the distal margin. The IBr_1 are short, between four and five times as broad as long, broadly V-shaped in a direct lateral view. The proximal and distal edges are parallel, both slightly everted. The proximal edge bears along the margin a few short irregularly placed spines. The distal edge bears, on either side of the median line, about eight regular teeth which begin one third of the distance from the median line and gradually increase in length to the anterolateral angle; this series of teeth is continued inward toward the median line by small, and progressively smaller, spines. The lateral edges are slightly produced and smooth. The anterolateral angles bear a few prominent blunted spines. In the center of the ossicle there is a prominent and sharp, though not especially high, median keel. The IBr_2 (axillaries) are broadly rhombic, with the lateral angles truncated, about twice as broad as long; the lateral edges are not quite so long as those of the IBr_1 and are produced and irregularly and coarsely spinous; the distal edges and the outer part of the proximal edge are slightly everted and finely spinous; a prominent keel resembling that on the IBr_1 runs nearly its whole length. Nine IIBr series are present, all 4(3+4). These resemble the IBr series and, like them, are prominently carinate; their lateral borders are produced and irregularly denticulate or spinous. Nine IIIBr series are present, all 4(3+4), resembling the IIBr series. The produced and denticulate borders extend as far as the base of P_2 externally, and as far as the fifth or sixth brachial internally.

The 28 arms are about 120 mm. long and in general resemble those of *O. gigantea.* The first two brachials are carinate. The brachials following have slightly everted and finely spinous distal edges and the dorsal, but not the lateral, surface covered with very numerous short fine spines. As the brachials become triangular the proximal edges lose their eversion, while that of the distal edges becomes more recumbent and more prominently spinous. The spinosity of the dorsal surface gradually becomes arranged in definite lines forming a series of sharp, serrate, longitudinal striations.

P_D is 14–16 mm. long, comparatively slender as in the other species of the genus and tapering very gradually to a delicate tip. It is composed of 28–30 segments all of which are broader than long. The distal outer and distal inner margins of the segments are sharply and very prominently carinate, this carination being very spinous, and on the proximal portion of the inner margin coarsely denticulate. A shallow concave trough runs between these ridges. The proximal segments are more or less spinous on the proximal (dorsal) surface. P_P is like P_D, but not nearly so long or so large.

P_1 is 14 mm. long with 26 segments, similar to P_D but more slender with the component segments somewhat longer, with their produced borders more spinous, and with the distal edges of the outer produced and spinous. P_2 is 8 mm. long with 17 segments, much more slender than P_1 with longer segments distally which have more produced and spinous distal edges. The following pinnules become progressively more slender with progressively longer segments which have coarsely spinous distal ends. P_3 is 7.5 mm. long. P_4 is 7 mm. long. P_5 is 6.5 mm. long. P_6 is 6 mm. long. The distal pinnules are 13 mm. long with 18–20 segments on which the crest of the prismatic ridge is finely spinous.

The disk, especially along the ambulacral grooves, is thickly beset with small rounded plates, which become produced along the ambulacra.

Notes.—The specimen from the Danish Expedition to the Kei Islands station 12 has about 40 arms (of which 25 are present) 150 mm. long; one postradial series is broken off at the distal end of the IBr_2, another at the $IIBr_1$. Of the IIBr series five are 4(3+4) and two are 2; three are missing. Of the IIIBr series six are 2 and three are 4(3+4). There are two IVBr series, both next the midradial line but on different postradial series.

The specimen from the Danish Expedition to the Kei Islands station 56 is small with 18 arms about 80 mm. long; the cirri have 39–43 segments and are 24–32 mm. long.

The specimen from the Danish Expedition to the Kei Islands station 58 is a magnificent example of the species with 24 arms 170 mm. long. Ten IIBr 4(3+4) series are present. There are four IIIBr series, two on each of two postradial series. On each ray one is internal and the other, on the other IIBr series, is external. The cirri are XXXIV, 72–76, from 70 to 75 mm. long.

The specimen from south of western Timor has 21 arms 175 mm. long. Of the ten IIBr series present eight are 4(3+4) and two are 2, both the latter being on the same IBr series. There is a single IIIBr 4(3+4) series, which is developed on the outer side of one of the two IIBr 2 series. The cirri have 63–65 segments and are up to 60 mm. in length. The dorsal pole of the centrodorsal is strongly convex and rugose.

This specimen differs from the type only in minor details. The type specimen, which is much broken, was said to have an arm length of about 120 mm. This estimate is undoubtedly much too short, as in all other dimensions the type is larger than the present specimen.

In general appearance this species is intermediate between *gigantea* and *annandalei*, though rather more like the former. It differs from *gigantea* in having keels on the proximal elements of the pairs of ossicles forming the division series as well as on the distal, and on the first brachials as well as on the second; in the more numerously segmented, more slender, and relatively longer cirri; in having more numerous arms (28 instead of 17); in the absence of interradial ridges separating the columns of cirrus sockets on the centrodorsal; in the much less spinous borders of the division series and lower brachials; and in having the IIIBr series 4(3+4) instead of 2. It differs from *annandalei* in being larger and more robust; in having no spines on the dorsal surface of the proximal ossicles; in having the ossicles of the division series with irregularly dentate produced lateral borders instead of smooth; in the much less spinous dorsal surface of the earlier brachials; and in the larger and stouter cirri.

Localities.—*Siboga* station 251; Arafura Sea, west of the Kei Islands (lat. 5°28′24″ S., long. 132°00′12″ E.); 204 meters; hard coral sand; December 8, 1899 [A. H. Clark, 1912, 1916, 1918, 1932; Gislén, 1934] (1, Amsterdam Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 12; 320 meters; sand; April 9, 1922 (1, C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 56; 345 meters; mud; May 10, 1922 (1, C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 58; 290 meters; mud; May 12, 1922 (1, C. M.).

South of western Timor (lat. 10°26′24″ S., long. 123°46′18″ E.); 256–292 meters; cable repair ship *The Cable*, Eastern Australasia and China Telegraph Company, July 1, 1928 [A. H. Clark, 1932] (1, B. M.).

Geographical range.—From the Kei Islands to Timor.

Bathymetrical range.—From 204 to 345 meters.

History.—This species was originally described in 1912 from a single specimen from *Siboga* station 251 under the name of *Thalassometra magna*. In 1916 it was listed as *Oceanometra magna*, and it was redescribed and figured under that name in 1918. In 1932 I recorded and gave notes on a second specimen that had been brought up by the cable repair ship *The Cable* off Timor, and in 1934 Prof. Torsten Gislén discussed the arm structure of this species.

OCEANOMETRA ANNANDALEI (A. H. Clark)

PLATE 15, FIGURES 45, 46

[See also vol. 1, pt. 2, figs. 222, p. 173, 515, 516, p. 283.]

Crotalometra eupedata (part) A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 406 (*Albatross* station 5116; characters).

Crotalometra annandalei A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 642 (description; Malay Archipelago, 30 fms.).

Thalassometra annandalei A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 551 (referred to *Thalassometra*; near *gigantea*; *Albatross* station 5116 [originally recorded as *eupedata*], 5280, 5503, 5504, 5506, 5536; abnormal specimens); Zool. Anz., vol. 39, No. 11/12, 1912, p. 425 (compared with *Th.* [*Oceanometra*] *magna*); Crinoids of the Indian Ocean, 1912, p. 195 (synonymy; detailed description; localities), fig. 35, p. 196; Die Crinoïden der Antarktis, 1915, p. 125 (shows characteristic features of *Anthometra adriani*).

Oceanometra annandalei A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 606 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 151 (in key; range), p. 153 (references).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 80, fig. 79, p. 81 (syzygial face); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 22, 23.

Diagnostic features.—All the ossicles of the division series and the first two brachials bear median keels and have smooth lateral borders which are not produced and a more or less spinous dorsal surface; the dorsal surface of the earlier brachials is more or less densely spinous. This is a rather slender species, with slender cirri; the 19–23 (usually 20) arms are 110–160 (usually 110–130) mm. long, and the cirri are 40–65 mm. long with 62–79 segments.

Description.—The centrodorsal is columnar with the tip truncated conical as in *Asterometra*, 5 mm. high and about 5 mm. broad at the base. The cirrus sockets are arranged in 10 columns, of usually three each, the columns of adjacent radial areas being closely crowded and with the sockets more or less alternating, while the two columns in each radial area are separated in the midradial line by a slightly concave median area of about half their width. The polar area of the centrodorsal has five more-or-less marked interradial ridges which terminate in five small tubercles about the apex.

The cirri are XXX, 62–79, 65 mm. long, and comparatively slender. The first three segments are approximately equal, short, about twice as broad as long. The segments following gradually increase in length, becoming about as long as broad on the fifth or sixth, and from half again to nearly twice as long as broad on the eighth or ninth. The next three or four segments are similar, the length then very slowly decreasing, the segments in the middle of the cirri being about as long as broad and those in the distal portion about twice as broad as long. The eighth, ninth, or tenth is a transition segment. Shortly after the transition segment the median portion of the distal dorsal edge of the segments begins to become prominent. This very slowly increases in height, arising from progressively more and more of the dorsal surface of the segments, which become progressively more and more carinate so that in the terminal 45 or 50 the dorsal surface is produced into a sharp, thin keel, straight in front, convex posteriorly, the outer edge parallel with the median line of the cirrus, in height equal to about one-third the lateral width of the segment which bears it. The opposing spine is small and blunt, arising from the entire dorsal surface of the penultimate segment, the apex subterminal or central, in height equal to about one third the diameter of the penultimate segment. The terminal claw is small, about equal in length to the penultimate segment, stout and moderately curved. The cirri are rounded in section in the basal third, later becoming strongly compressed laterally and, when viewed from the side, somewhat broader.

The ends of the basal rays are visible as dorsoventrally elongated tubercles in the angles of the calyx. Deep, though narrow, subradial clefts are present.

The radials are very short, convex proximally and concave distally, with a small sharp tubercle in the median portion of the proximal border. The IBr_1 are about three times as broad as long with the proximal border convex and the distal border concave, in close lateral opposition and extending rather well up into the angles of the calyx; the lateral edges are more or less denticulate, and there is a low, though sharp, serrate median keel. The IBr_2 (axillaries) are slightly longer than broad, shield-shaped, with the proximal border produced into a rounded projection incising the IBr_1, the anterior edges concave, the anterior angle somewhat produced, and the lateral edges somewhat denticulate; there is a sharp serrate median keel in the proximal two-thirds. The IIBr series are 4(3+4), rarely 2, and are strongly convex dorsally; they are in close lateral apposition and are sharply flattened laterally, like the IBr series; the lateral edges are produced and strongly denticulate. The syzygial pair formed by the two outer elements is centrally constricted with the lateral angles produced as in the other species of the genus.

The 20 arms are 115 mm. long. The first brachials are short, slightly longer exteriorly than interiorly, interiorly united, and somewhat incised by the second, which are nearly twice as large and have a rounded posterior projection. The first and second brachials, like the two elements of the IBr series, have a slightly marked median carination. The first syzygial pair (composed of brachials 3+4) is not quite so long as broad and is somewhat constricted centrally. The next five or six brachials are almost oblong, about twice as broad as long, with the dorsal profile rather strongly concave. The brachials following become wedge-shaped and soon triangular, nearly as long as broad, and after the middle of the arm wedge-shaped again and about as long as broad. At first the arms are evenly rounded dorsally, but after the basal third they gradually become compressed and more sharply rounded dorsally, and in the outer half very narrow and very sharply rounded dorsally, though not really carinate. After the basal third of the arms the brachials develop slightly projecting and finely spinous distal edges. The dorsal, but not the dorsolateral, side of the fourth and following brachials is covered with fine short spines which gradually become coarser after the proximal third of the arm and tend to arrange themselves in longitudinal lines. The ossicles of the division series and arm bases have strongly denticulate borders.

Syzygies occur between brachials 3+4, again from between brachials 25+26 to between brachials 35+36 (usually in the vicinity of the twenty-ninth), and distally at intervals of from 5 to 17 (usually from 7 to 9) muscular articulations.

P_D 12 mm. long, moderately stout in the proximal half but becoming slender distally, with about 20 segments all of which are approximately as long as broad, those in the basal two-thirds being strongly carinate. P_1 10 mm. long, similar to P_D but less stout basally. P_2 6 mm. long, much more slender than P_1, tapering evenly from the base to the tip, with 15 segments of which the proximal four or five are about as long as broad, those following becoming longer than broad and about twice as long as broad terminally. P_3 is similar, 6 mm. long. P_4 and the following pinnules are 5 mm. long with about 13 segments, less slender distally than those preceding; the segments have slight overlapping spines developed on the distal edge along the dorsal crest. The distal pinnules are 10 mm. long, rather slender, composed of about 20 segments of which the first is short and crescentic, the second is trapezoidal and about as broad distally as its median length, and those following are half again as long as broad, with the terminal four or five disproportionately small; the dorsal crest is sharp and somewhat spinous.

The perisome over the gonads is encased in well-formed and definite plates of very different sizes and shapes some of which, near the borders of the pinnulars, are longitudinally elongated. The side- and covering-plates resemble those of *O. gigantea*.

Notes.—Of the five specimens from *Albatross* station 5367 one has 20 arms 85 mm. long and the cirri 40–47 mm. long; all the IIBr series are 4(3+4). Another has 19 arms 115 mm. long and the cirri 40–45 mm. long; of the nine IIBr series seven are 4(3+4) and two are 2. Another has 23 arms 110 mm. long, and the cirri 40–45 mm. long; the ten IIBr series and the three IIIBr series are 4(3+4). Another has 19 arms; of the nine IIBr series six are 4(3+4) and three are 2. The fifth has 20 arms with the ten IIBr series all 4(3+4).

One of the three specimens from *Albatross* station 5503 has 20 arms 120 mm. long; another has 20 arms 115 mm. long; and the third has 19 arms 130 mm. long.

Of the two specimens from *Albatross* station 5506 one has 19 arms 90 mm. long and the other is small with 15 arms.

The specimen from *Albatross* station 5280 has 21 arms 130 mm. long and the cirri 50–60 mm. long; there are four IIBr 2 series, two of which bear externally IIIBr 4(3+4) series.

A small specimen from *Albatross* station 5116 has 11 arms 60 mm. long; one IIBr 4(3+4) series is present.

All the specimens from the Philippines are somewhat smaller and more slender than the type specimen in the Indian Museum, with which they were compared directly. The division series and lowest brachials are usually slightly more spinous and thus more nearly like the brachials immediately following; there is, however, considerable variation in this feature.

Abnormal specimen.—The specimen from *Albatross* station 5536 has 22 arms 160 mm. long, and the cirri 40–50 mm. long. Of the nine IIBr series eight are 4(3+4) and one is 2. The axillary of one of the IIBr 2 series bears on its inner face another axillary and on its outer face the first elements of a IIIBr 2 series which is supported equally by the IIBr axillary and by the outer side of the IIIBr axillary.

Localities.—*Investigator;* Malay Archipelago; 55 meters [A. H. Clark, 1909, 1912, 1915, 1916, 1918] (2, U.S.N.M., 35577; I. M.).

Albatross station 5367; North Balabac Strait; Balabac Light bearing S. 65° W., 14.3 miles distant (lat. 8°06′00″ N., long. 117°17′10″ E.); 124 meters; coral sand; January 5, 1909 (5, U.S.N.M., 35571, 35948).

Albatross station 5504; in the vicinity of northern Mindanao; Macabalan Point, Mindanao, bearing S. 39° E., 6 miles distant (lat. 8°35′30″ N., long. 124°36′00″ E.); 366 meters; bottom temperature 12.4° C.; green mud; August 5, 1909 [A. H. Clark, 1911, 1912, 1915, 1918] (1, U.S.N.M., 35573).

Albatross station 5503; in the vicinity of northern Mindanao; Macabalan Point Light, Mindanao, bearing S. 31° E., 6.6 miles distant (lat. 8°36′26″ N., long. 124°36′08″ E.); 413 meters; bottom temperature 11.7° C.; green mud; August 4, 1909 [A. H. Clark, 1911, 1912, 1915, 1918] (3, U.S.N.M., 35570).

Albatross station 5501; in the vicinity of northern Mindanao; Macabalan Point Light, Mindanao, bearing S. 35′ E., 8.2 miles distant (lat. 8°37′37″ N., long. 124°35′00″ E.); 391 meters; bottom temperature 12.4° C.; fine sand and gray mud; August 4, 1909 (1, U.S.N.M., 35959).

Albatross station 5506; in the vicinity of northern Mindanao; Macabalan Point, Mindanao, bearing S. 41° E., 12.2 miles distant (lat. 8°40′00″ N., long. 124°31′45″ E.);

479 meters; bottom temperature 11.7° C.; green mud; August 5, 1909 [A. H. Clark, 1911, 1912, 1915, 1918] (2, U.S.N.M., 35574).

Albatross station 5536; between Negros and Siquijor; Apo Island (C.) bearing S. 26° W., 11.8 miles distant (lat. 9°15′45″ N., long. 123°22′00″ E.); 510 meters; bottom temperature 11.9° C.; green mud; August 19, 1909 (1, U.S.N.M., 35572).

Albatross station 5280; China Sea, off southern Luzon; Malavatuan Island (N.) bearing S. 60° W., 6.1 miles distant (lat. 13°55′20″ N., long. 120°25′55″ E.); 353 meters; bottom temperature 9.8° C.; gray sand; July 17, 1908 [A. H. Clark, 1911, 1912, 1915, 1918] (1, U.S.N.M., 35575).

Albatross station 5116; Balayan Bay; Sombrero Island bearing N. 69° E., 2.5 miles distant (lat. 13°41′00″ N., long. 120°47′05″ E.); 366 meters; bottom temperature 10.1° C.; January 20, 1908 [A. H. Clark, 1909 (as *Crotalometra eupedata*), 1911, 1912, 1915, 1918] (1, U.S.N.M., 35576).

Geographical range.—From the Malay Archipelago northward to Luzon, Philippine Islands.

Bathymetrical range.—From 55 to 510 meters; the average of 9 records is 339 meters.

Thermal range.—From 9.8° to 12.4° C.; the average of 7 records is 11.4° C.

History.—A supposed young specimen of *Crotalometra eupedata* recorded on May 13, 1909, from *Albatross* station 5116 proved to belong to this species which was described on June 19, 1909, under the name of *Crotalometra annandalei* from two specimens dredged by the Royal Indian Marine Survey steamer *Investigator* in the Malay Archipelago in 30 fathoms. In 1911 I recorded *Thalassometra annandalei* from *Albatross* stations 5280, 5367, 5503, 5504, 5506, and 5536, giving notes on the specimens, and redetermined the small 11-armed specimen from station 5116. In my description of *Thalassometra* (*Oceanometra*) *magna* published in 1912 I compared it with *Thalassometra annandalei.* In my memoir on the crinoids of the Indian Ocean published later in 1912 I redescribed and figured *Thalassometra annandalei* and gave the synonymy and range. In my memoir on the crinoids of the Antarctic published in 1915 I compared the characteristic features of *Anthometra adriani* with corresponding features in *Thalassometra annandalei.* In 1916 I first listed this species as *Oceanometra annandalei.* In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 I included *annandalei* in the key to the species of *Oceanometra* and gave the synonymy and range.

Prof. Torsten Gislén in 1924 and 1934 discussed various features in the structure of *Oceanometra annandalei.*

Genus LEILAMETRA A. H. Clark

Leilametra A. H. Clark, Ann. Mag. Nat. Hist., ser. 10, vol. 10, No. 58, October 1932, p. 379 (diagnosis; genotype *L. necopinata*, sp. nov.).

Diagnosis.—A genus of Thalassometrinae including species with 10 arms in which the elements of the division series and lower brachials have spinous borders and the brachials beyond the proximal have a spinous dorsal surface and very spinous distal edges; the cirri are very long, with up to 83 segments, slender, and nearly straight, being only slightly recurved distally, composed of segments with produced and spinous distal ends, but broadly rounded dorsally instead of carinate, the penultimate without an opposing spine; P_2 resembles P_1 and is only very slightly smaller, and the segments of the genital pinnules are not expanded.

Geographical range.—Known only from south of Lombok, in the Lesser Sunda Islands.

Bathymetrical range.—Known only from 1,097 meters.

Remarks.—The genus *Leilametra* is closely related to *Thalassometra* from which it differs in the long straight cirri the distal segments of which are without dorsal processes and in having P_2 resembling P_1 instead of P_3 and the following pinnules. The relation between *Leilametra* and *Thalassometra* is somewhat analogous to that between *Craspedometra* and *Heterometra*.

LEILAMETRA NECOPINATA A. H. Clark

PLATE 16, FIGURES 48, 49

Leilametra necopinata A. H. CLARK, Ann. Mag. Nat. Hist., ser. 10, vol. 10, No. 58, October 1932, p. 378 (listed), p. 379 (south of Lombok, 600 fathoms; description), pl. 13; Proc. Biol. Soc. Washington, vol. 47, Feb. 9, 1934, p. 10 (new genus and species discovered by *The Cable*).

Description.—The centrodorsal is of moderate size, apparently columnar basally, with the bare dorsal pole low, rounded, conical, 3 mm. in diameter. The cirri are arranged in 10 columns of 2, rarely 3, each, the columns being closely crowded, though the proximal cirrus sockets are somewhat more separated in the radial than in the interradial lines.

The cirri are XXII, 55–83 (in the longest cirri nearer the latter), up to 90–95 mm. in length, and slender. They are of uniform width in the proximal half, in the distal half very slowly and almost imperceptibly tapering to a fine tip. The first segment is very short, the second and third are about three times as broad as long, the fourth is twice as broad as long, the fifth is longer, nearly as long as broad, the sixth is about one-third again as long as broad, and the seventh, which is a transition segment, is about twice as long as broad or slightly longer. The next three or four segments are of the same length, after which the length of the segments very slowly decreases so that those in the distal half of the cirri are from half again to twice as broad as long, the terminal segments again increasing in length so that the antepenultimate is about as long as broad. After the transition segment the distal ends of the segments dorsally become slightly produced and very finely spinous, at first only in the central portion, but later more and more extensively, finally involving the entire distal edge on the dorsal side. The dorsal profile of the segments is straight, distally becoming somewhat convex, and rises from the proximal to the distal end, so that the dorsal profile of the cirri as a whole is serrate. But the dorsal surface of the cirri is always broadly rounded, never becoming carinate. There is no opposing spine. The terminal claw is long, longer than the segment that bears it, slender, evenly tapering, and slightly and evenly curved.

The ends of the basal rays are conspicuous as rhombic areas in the interradial angles of the calyx. Deep but narrow subradial clefts are present.

The radials are short and bandlike, about eight times as broad as long in the median line, shorter laterally than in the median line, evenly curved, and with the median portion raised into a low and very broadly rounded elevation. The IBr_1 are about four times as broad as long, with the proximal and distal edges parallel and the lateral borders produced so as to be in contact and more or less broadly swollen. The anterolateral angles are broadly truncated, so that a rather narrowly rhombic water-pore with the long axis at right angles to the dorsoventral axis of the animal is formed. The midradial line rises into a broadly rounded elevation. The IBr_2 (axillaries) are twice as broad as long or somewhat broader, triangular, with the lateral angles rather broadly truncated. The proximal border is very slightly convex in the middle and is slightly bowed downward over the truncated anterolateral angles of the IBr_1. The distal edges are slightly everted and are armed with exceedingly fine spines, and the proximal two-thirds of the median line is raised into a low and broadly rounded elevation. The outer portions of the proximal border are produced into a slightly everted flange with a plain or sometimes broadly crenulate edge.

The 10 slender arms are 180 mm. in length. The first brachials are wedge-shaped, about four times as broad as the median length, and nearly twice as long exteriorly as interiorly. The proximal border is slightly convex and is slightly everted. The inner borders of the two first brachials borne by each axillary are in contact and are slightly everted in the proximal half or two-thirds, the distal portion being slightly swollen and sometimes armed with a spine or several spines. The distal border is very slightly concave and the lateral portions are very slightly prominent. The second brachials are about twice as large as the first brachials, and are trapezoidal. They are in contact interiorly, and there is a narrow horizontally elongated water pore beneath their inner ends. The first syzygial pair (composed of brachials 3+4) is approximately oblong, half again as broad as long. The hypozygal is slightly longer interiorly than exteriorly, and the epizygal has practically parallel sides. The next three or four brachials are somewhat irregularly oblong, about three times as broad as long, with the dorsal surface roughened and the proximal and distal edges slightly everted and armed with exceedingly fine spines. The succeeding brachials are very obliquely wedge-shaped, almost triangular, half again as broad as the greatest length, with the surface roughened and the proximal and distal edges armed with a band of very fine spines, soon becoming triangular and somewhat longer, at the middle of the arm becoming obliquely wedge-shaped again, and nearly or quite as long as broad, and terminally longer than broad with very oblique ends. After the proximal third of the arms the roughness of the dorsal surface of the brachials becomes more pronounced, resolving itself into numerous short spines with a broad base which are directed distally and tend to be arranged in rows, and at the same time the production and spinosity of the distal edges of the brachials increases.

The first syzygy is between brachials 3+4, the second usually between brachials 15+16, sometimes between brachials 16+17, and once between brachials 17+18, and the third is from between brachials 19+20 to between brachials 24+25. The distal intersyzygial interval is from 5 to 12 (usually 7 or 8) muscular articulations.

P_1 is 10 mm. long and is composed of 18 segments. It is stout basally and tapers evenly and gradually to a delicate tip. The first segment is about half again as broad as long, and those following gradually increase in length to the eighth, which is about as long as broad or slightly broader than long. The following segments are similar, becoming somewhat longer terminally. The outer side of the segments is sharply and broadly flattened. The edge of the segments on the distal side of the flattened outer surface is broadly rounded, somewhat elevated, and finely spinous; viewed from the side it is seen to be somewhat convex. The proximal and distal angles of the outer ends of the segments from the fourth or fifth onward extend beyond the bases of the segments succeeding. The second and following segments bear high carinate processes with the crest parallel to the axis of the pinnule.

P_2 is 8 mm. long with 14 or 15 segments. It resembles P_1 and is only slightly less stout basally.

P_3 is 6 mm. long with 11 or 12 segments and resembles the pinnules preceding, but is less stout. As in the preceding pinnules, the carinate processes on the segments are well developed.

P_4 is 6 mm. long with 10 segments and resembles P_3, but the carinate processes on the segments are not quite so strongly developed.

P_5 is 6 mm. long with 10 segments and resembles P_4. On the next few pinnules the carinate processes on the segments disappear.

The distal pinnules are 15 mm. long with 18 or 19 segments.

The color is yellow with the basal portion of the cirri, including the proximal two-thirds of the transition segment, darker, especially on the transition segment itself.

Locality.—South of Lombok Island (lat. 8°59′54″ S., long. 115°50′48″ E.); 1,097 meters; cable repair ship *The Cable*, Eastern Australasia and China Telegraph Co. [A. H. Clark, 1932, 1934] (1, B. M.).

Genus THALASSOMETRA A. H. Clark

Antedon (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 107, and following authors.

Thalassometra A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 359 (diagnosis; genotype *Antedon villosa* A. H. Clark, 1907); Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 245 (characters; genotype); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 136 (referred to the Thalassometridae); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211 (referred to the Thalassometridae), p. 212 (occurs in Japan and the Crozet, Aleutian, Galápagos and Hawaiian Islands), p. 275 (proximal ornamentation); Amer. Nat., vol. 42, No. 503, 1908, p. 723 (range; habitat); Geogr. Journ., vol. 32, No. 6, 1908, p. 602 (range; habitat); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 1 (revision), p. 14 (list of species included in the genus as restricted); Vid. Medd. Naturh. Foren. København, 1909, p. 138 (transition segment in the cirri comparable to that of *Comatella maculata*); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 551 (*Crotalometra* [*Oceanometra*] *annandalei* referred to this genus); vol. 40, 1911, p. 12 (occurs in deep water in the Atlantic, but does not intrude on Polar-Pacific species); Crinoids of the Indian Ocean, 1912, p. 10 (2 species occur in the Hawaiian Islands), p. 11 (occurs both east and west of Ceylon), p. 12 (represented in the Red Sea and in the southeastern African regions), p. 14 (certain species are characteristic of the oceanic fauna; absent from the American side of the Atlantic, and from the European side north of the Bay of Biscay), p. 23 (distribution in the East Indies in detail), p. 59 (in key), p. 195 (original reference; genotype); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1914, pp. 4 and following (occurs in both Atlantic and Indo-Pacific; range); Die Crinoïden der Antarktis, 1915, p. 111 (synonymy; range), p. 181 (both Atlantic and Indo-Pacific; range in each); Unstalked crinoids of the *Siboga*-Exped., 1918, pp. 145, 147 (in key; range), p. 166 (key to the included species); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range; list of Atlantic species).—Mortensen, Handbook of the echinoderms of the British Isles, 1927, p. 25 (northeast Atlantic species; in key).—Gislén, Vid. Medd. Dansk Naturh. Foren. København, vol. 83, 1927, p. 6; Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 7.—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36. No. 249, April 1929, p. 651.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20.

Diagnosis.—A genus of Thalassometridae in which the arms are dorsally rounded to the tips; the lower segments of the genital pinnules are not appreciably expanded; P_1 is much larger and stouter than P_2, which resembles the pinnules following; the cirri are recurved distally, the short outer segments bearing dorsal spines; the division series and arm bases are more or less thickly beset with small spines, at least along the borders of the ossicles; and the arms are less than 15 (usually 10) in number, with the IIBr series, when present, usually 4(3+4), sometimes 2.

Geographical range.—From the western Aleutian Islands, the Galápagos Islands and Panama, and the Kermadec Islands westward to east Africa from Sokotra to the Crozet Islands, and from Tristan da Cunha and Ascension Island northward to the Canary Islands.

Bathymetrical range.—From 598 to 2,925 meters.

Thermal range.—From 1.2° to 7.88° C.

Remarks.—The genus *Thalassometra* is closely related to *Oceanometra*, though on the basis of our present meager knowledge it appears to be quite distinct. It is also closely related to *Leilametra*, which differs from it only in the long straight tapering cirri without dorsal spines or carination, recalling the relation between *Craspedometra* and *Heterometra*, and in the large size of P_2, which is intermediate in size and character between P_1 and P_3 instead of being small like P_3. The differences between *Thalassometra* and *Stiremetra* are not very significant, though they appear to be constant.

Nearly all the species of *Thalassometra* are known only from a few mutilated individuals from a single dredge haul, and in most cases the descriptions leave much to be desired.

The 16 species of the genus form, on the whole, a fairly homogeneous unit. The species with numerous coarse spines or tubercles—*bispinosa*, *electrae*, *agassizii*, and *villosa*—in which the IIBr series are 2 instead of the usual 4(3+4) may possibly represent a generic type distinct from those with very fine spines, but as yet we do not know enough about them to enable us to form any very definite opinion.

This genus and *Stiremetra* are the only representatives of the family Thalassometridae at depths greater than 1,600 meters.

History.—As originally proposed in my first revision of the old genus *Antedon* published in 1907, the genus *Thalassometra* included all the species known at that time that are now included in the family Thalassometridae, with the exception of (*Parametra*) *compressa* and *orion*, which were placed in *Charitometra*, but transferred to *Thalassometra* in the following year. Since then *Thalassometra* has been progressively restricted in scope by the establishment of *Stylometra* in 1908; *Cosmiometra*, *Crotalometra*, *Parametra*, *Stenometra*, and *Stiremetra* in 1909; *Aglaometra* in 1913; *Daidalometra* (separated from *Stenometra*) in 1915; *Oceanometra* in 1916; and *Horaeometra* and *Lissometra* (separated from *Parametra*) in 1918. *Leilametra* was established in 1932, based upon a newly discovered type, and *Koehlermetra* is separated from *Crotalometra* herein.

KEY TO THE SPECIES IN THE GENUS THALASSOMETRA

a^1. Centrodorsal with the cirri arranged in 10 definite columns, two in each radial area.

  b^1. Edges of the elements of the division series and lower brachials, and sometimes the dorsal surface also, with coarse blunt spines or tubercles, never finely spinous.

    c^1. Elements of the division series and lower brachials bordered with numerous coarse blunt spines; eighth and following brachials each with 2 or 3 long curved spines near the distal edge; lower pinnules very spiny; 10 arms about 50 mm. long and the cirri about 17 mm. long with 30–35 segments (between Marion Island and the Crozets; 2,925 meters).

bispinosa (p. 154)

c^2. Elements of the division series and lower brachials with large well-spaced tubercles on the dorsal surface; lower pinnules not spiny; 10 arms; cirri about 28 mm. long with 29–43 (usually about 40) segments (northwest of Sokotra; 2,194 meters)--------**electrae** (p. 156)

b^2. Edges of the elements of the division series, and often the dorsal surface also, with numerous fine spines.

c^1. Cirri with more than 30 segments.

d^1. Cirri with 60–71 segments, 45–50 mm. long.

e^1. Elements of the division series and lower brachials smooth dorsally, or with a few low inconspicuous tubercles; synarthrial tubercles rather prominent, but no median carination; 10–13 arms 80–120 mm. long, and the cirri 50 mm. long with 62–71 segments (Kurrachi to the Maldive Islands and southwestward to Mozambique; 797–1,398 meters)--------**attenuata** (p. 163)

e^2. Elements of the division series and lower brachials with spines on the dorsal surface, and with a more or less narrow spinous median carination.

f^1. Elements of the division series and lower brachials with the edges all around strongly everted and coarsely spinous, with a coarsely spinous median carination, and with a few coarse spines scattered over the dorsal surface; 10 arms; cirri 30–45 mm. long, with 48–66 (usually 54–66) segments (Timor Sea to Luzón; 214–960 meters). **hirsuta** (p. 165)

f^2. Elements of the division series and lower brachials with the edges less strongly everted; spinosity coarser, the spines more uniform in size and more thickly distributed over the dorsal surface of the ossicles, also larger, so that there is less difference between the spines of the dorsal surface and those of the everted edges; median carination more rounded and studded with spines resembling those of the general dorsal surface; 10 arms about 95 mm. long, and the cirri 45 mm. long with 57+ segments (Flores Sea; 794 meters)--------**margaritifera** (p. 168)

d^2. Cirri with 40–55 segments, 30–40 mm. long.

e^1. Spines confined to the edges of the elements of the division series and earlier brachials.

f^1. Elements of the division series and first two brachials with the proximal and distal edges prominently everted and irregularly and coarsely dentate, the dentations with numerous fine spines on their tips, the lateral borders perfectly plain without spines or tubercles and sharply, though narrowly, flattened against their neighbors; 10 arms; cirri 40 mm. long with 34–46 segments (Maldive and Nicobar Islands, 384 meters)--------**marginata** (p. 168)

f^2. Elements of the division series and lower brachials with the proximal and distal edges not dentate, evenly spinous.

g^1. Elements of the division series and first two brachials bordered with thickly set spines; triangular proximal brachials with projecting distal edges which increase in prominence distally, in the distal third of the arms becoming long curved overlapping spines; 10–12 (usually 10) arms 110 mm. long, and the cirri 32 mm. long with 50–55 segments (Hawaiian Islands; 545–641 meters)--**hawaiiensis** (p. 170)

g^2. Elements of the division series and first two brachials with the edges finely spinous; distal edges of the brachials not produced; 10 arms 40 mm. long, and the cirri 30 mm. long with 40 segments (Sagami Bay, Japan; 631 meters)--**latipinna** (p. 171)

e^2. Elements of the IBr series and lower brachials with numerous thickly set very fine spines on the dorsal surface; 10 arms 60–80 mm. long, and the cirri 30 mm. long with 50–55 segments (Meangis Islands to southwestern Japan; 804–914 meters----**gracilis** (p. 173)

c^2. Cirri with 25 segments; elements of the division series and first two brachials with sharp straight edges fringed with spines, and very slightly flattened sides; 10 arms 30 or 35 mm. long (Kermadec Islands; 1,152 meters)--------**echinata** (p. 176)

a^2. Centrodorsal with the cirrus sockets never in 10 definite columns, the sockets either irregularly arranged with three under each radial, or in 15 columns of which the central one in each radial area may be reduced to a single socket

b^1. Cirri with more than 40 (40–60+) segments; spines on the division series and arm bases coarse, usually more or less separated; IIBr series, when present, 2.

c^1. Spines on the elements of the division series and lower brachials confined almost entirely to the proximal and distal edges; centrodorsal with two converging columns of cirrus sockets on the outer sides of each radial area, with the central column represented by a single socket; larger, the 10–12 arms about 175 mm. long and the cirri about 40 mm. long with 60+ segments (Galápagos Islands and off Panama; 598–1,429 meters)__**agassizii** (p. 158)

c^2. Dorsal surface of the division series and lower brachials studded with stout, well-spaced, sharply conical spines, the edges of the ossicles everted and crenulate, dentate, or serrate, but not conspicuously spiny; cirri in 15 crowded columns of 2 or 3 each; smaller, the 10–11 arms 95 mm. long and the cirri 33 mm. long with 40–50 (usually about 50) segments (western Aleutian Islands; 1,912 meters)____________________________________**villosa** (p. 162)

b^2. Cirri with less than 40 (seldom more than 35) segments; spines on the division series and arm bases very fine and, at least along the edges, crowded; IIBr series, when present, 4(3+4).

c^1. Elements of the division series and arm bases thickly covered dorsally with excessively fine spines which are often grouped on irregular pedicels suggesting paxillae; larger, the 11 arms 80 mm. long and the cirri 20–25 mm. long with 31–38 (usually about 35) segments (Nicobar Islands; 1,024 meters)_________________________________**peripolos** (p. 178)

c^2. Elements of the division series with scattered fine spines, or with finely spinous edges; smaller, the arms mostly apparently about 50 mm. long.

d^1. Scattered spines on the elements of the division series and arms bases; 25–35 cirrus segments

e^1. Spines on the division series and arm bases numerous; 25–30 cirrus segments (Ascension Island; 768 meters)____**multispina** (p. 180)

e^2. Spines on the division series and arm bases few; 35 cirrus segments_(Tristan da Cunha; 1,005 meters)____**aetosa** (p. 182)

d^2. Elements of the division series and arm bases without spines except along the proximal and distal edges; brachials with the distal border thickened, forming a transverse crest that bears only a few very fine spines; 21 cirrus segments (Canary Islands; 1,330–1,340 meters)____**omissa** (p. 184)

THALASSOMETRA BISPINOSA (P. H. Carpenter)

Antedon bispinosa P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 115 (description; *Challenger* station 147), pl. 20, figs. 3, 4.—Hartlaub, Bull. Mus. Comp. Zoöl., vol. 27, No. 4, 1895, pp. 130, 131 (systematic position; bathymetric relationships), p. 134 (compared with *A. agassizii*).—Shipley, Antarctic Manual, 1901, Chapter 18, p. 269.—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (identity).—Koehler, Echinodèrmes des mers d'Europe, vol. 1, 1924, p. 58 (depth).

Thalassometra bispinosa A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed); Amer. Nat., vol. 42, No. 500, 1908, p. 542 (belongs to a group characteristic of the oceanic area); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (same); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14 (listed); Crinoids of the Indian Ocean, 1912, p. 208 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 47 (published references to the specimen in the B. M.; *Challenger* station 147); Journ. Washington Acad. Sci., vol. 5, No. 3, 1915, p. 81 (Antarctic; range); Die Crinoïden der Antarktis, 1915, p. 105 (collected by the *Challenger*), p. 107 (in key to Antarctic crinoids), p. 112 (synonymy; habitat), p. 169 (deep water Antarctic species), p. 170 (range and relationships), p. 192 (further discussion); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 166 (in key; range), p. 170 (references).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 7, No. 27 (notes).

Diagnostic features.—The elements of the division series and lower brachials are bordered with numerous coarse blunt spines, and the eighth and following brachials each have 2 or 3 long, curved, overlapping spines near the distal edge; the lower pinnules are very spiny; and the cirri are arranged in 10 definite columns on the centrodorsal. The 10 arms are about 50 mm. long and the cirri are about 17 mm. long with 30–35 segments.

Description.—The centrodorsal is almost columnar; according to the figure the cirrus sockets are arranged in 10 columns with usually two to a column; the columns seem to be in close apposition all around the centrodorsal.

The cirri are about XXV, 30–35, according to the figure about 17 mm. long. The three basal segments are almost saucer-shaped and those following become nearly or quite twice as long as broad, soon becoming shorter again, about half again as broad as long, and acquiring a marked dorsal keel which becomes reduced to a spine on the later segments.

The distal edge of the radials is fringed with blunt spines. The IBr_1 are short with the proximal and distal borders fringed with blunt spines. The IBr_2 (axillaries) are pentagonal with a curved base, overlapping the IBr_1 laterally. The dorsal surface of the elements of the IBr series is strongly convex and spinous, and their borders are fringed with blunt spines. They are strongly flattened laterally against their neighbors.

The 10 arms are about 50 mm. long. The first brachials are rounded and short in the median line, but with depressed lateral portions which meet one another by flattened surfaces all around the calyx. The second brachials are more square and scarcely project backward into the first. The margins of the lower brachials are fringed with spines. The eighth and following brachials become quadrate and slightly overlapping, with two or three large curved spines near the distal edge which become long and prominent in the outer portions of the arms.

Syzygies occur between brachials 3+4, again from between brachials 12+13 to between brachials 15+16, and distally at intervals of 4 or more muscular articulations.

P_1 is much larger than its immediate successors, with the three or four basal segments somewhat flattened on the outer side and the second–fifth with the inner edge slightly keeled and folded upward. P_a is but little larger than P_2, and the pinnules following become gradually longer, with overlapping spinous segments.

The disk is 6 mm. in diameter and is strongly plated. The brachial ambulacra are irregularly plated. The pinnule ambulacra have large covering plates and ill defined side plates. Sacculi are rare.

The color in alcohol is white with large dark brown patches on the calyx.

Notes.—The preceding description is adapted from the original description by Carpenter with a few additions from his figures. Examination of the type specimen in London showed that this is a well developed and comparatively large species. Gislén, who also examined the type specimen, wrote that the cirri are arranged in 10 columns on the centrodorsal. The brachials have stout tubercles only, spines along the border and in the middle of the synarthrial pairs, and no fine spinosity. He said it is closely related to *Stenometra*, to which genus it ought, perhaps, to be referred. The lesser number of arms than in *Stenometra*, he said, is of less importance.

Locality.—*Challenger* station 147; between Marion Island and the Crozets (lat. 46°16′ S., long. 48°27′ E.); 2,925 meters; bottom temperature 1.2° C.; diatom ooze; December 30, 1873 [P. H. Carpenter, 1888; Hartlaub, 1895; Shipley, 1901; A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1915, 1918; Koehler, 1924; Gislén, 1928] (1, B. M.).

History.—*Antedon bispinosa* was described and figured by Dr. P. H. Carpenter in his report on the comatulids of the *Challenger* expedition published in 1888. In 1895 Dr. Clemens Hartlaub discussed its systematic position and bathymetrical relationships, and compared it with his new species *Antedon agassizii.* It was listed as *Antedon bispinosa* by Sir Arthur E. Shipley in 1901, and by Dr. Otto Hamann in 1907.

In my revision of the genus *Antedon* published in 1907 *bispinosa* was transferred to the new genus *Thalassometra.* In two papers published in 1908 *Thalassometra bispinosa* was said to belong to a group characteristic of the oceanic area. In my revision of the family Thalassometridae published in 1909 it was listed as *Thalassometra bispinosa,* and it was included under this name, with the synonymy and range, in my memoir on the crinoids of the Indian Ocean published in 1912. In a paper on the crinoids of the British Museum published in 1913 I gave a brief note on the type specimen of *Thalassometra bispinosa,* and listed it from the Antarctic, with the range, in 1915. In my memoir on the crinoids of the Antarctic published in 1915 *Thalassometra bispinosa* was discussed at considerable length. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *bispinosa* was included in a key to the species of *Thalassometra* and the synonymy and range were given. Prof. René Koehler mentioned this species in 1924, and in 1928 Prof. Torsten Gislén published additional notes on the type specimen.

THALASSOMETRA ELECTRAE John

Thalassometra, n. sp., A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 51; Crinoids of the Indian Ocean, 1912, p. 208; Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 70; John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936 (Jan. 1, 1937), p. 101, 104, 105.

Thalassometra electrae John, Ann. Mag. Nat. Hist., ser. 10, vol. 20, August 1937, p. 161.

Diagnostic features.—The elements of the division series and lower brachials are bordered with numerous coarse blunt spines, and the dorsal surface is studded with large well spaced tubercles; the proximal pinnules are not spiny; and the cirri are arranged in 10 definite columns on the centrodorsal. There are 10 arms (all broken off at the base in the single known specimen), and the cirri are about 28 mm. long with 29–43 (usually about 40) segments.

Description.—The centrodorsal is a fairly high rounded cone. Its edge is produced into slight interradial corners. The dorsal pole is large and rounded and is beset with long coarse tubercles. The cirrus sockets are arranged in 10 evenly spaced columns, 2 in each radial area, and there are 2, exceptionally 3, sockets in each column.

The cirri are XXII, 29–43, usually about 40, about 28 mm. long. The first three segments are broader than long, the third a little longer than the second, and the second than the first. The fourth segment is constricted centrally and is about one and one-third times as long as the least width. The distal edge of each of these four segments is strongly produced forward and outward to form a cup around the base of the next; the edge of the cup is denticulate. The fifth–seventh segments are slightly more than twice as long as broad; on each cirrus one or another of them is a transition segment with the distal third or quarter white and glossy, like the succeeding segments, and the proximal part a dull yellow like the preceding segments. Distally the segments gradually decrease in length, at about the fifteenth becoming as broad as long; beyond the fifteenth all are slightly broader than long. Toward the end of the cirrus the segments become progressively smaller. The fifth–seventh segments show the beginnings of a dorsal spine. This rapidly increases in size. By the ninth–twelfth segments it is spinelike, arising from the distal fifth of the dorsal edge. It becomes much stronger distally. About the twentieth–twenty-fifth segment it arises from the entire dorsal edge. On these more distal segments its apex is subterminal. The distal edge of all the segments beyond the fourth is produced into a delicate, transparent, finely dentate collar which is narrow on the more proximal segments, and wider, especially on the dorsal side, on the distal segments. The opposing spine arises from nearly the whole of the dorsal edge of the penultimate segment; it is strong and is directed a little forward. The terminal claw is strong and curved.

The radials are comparatively long, in the midradial line about one-sixth as long as broad. Their distal edges are concave. The IBr_1 are four times as broad as long, narrower distally than proximally, strongly rounded dorsally, widely separated from each other and not incised by the IBr_2. The proximal edge is convex, the distal concave. The IBr_2 (axillaries) are a little broader than long with strongly rounded sides. The proximal edge is gently convex, not angular. The distal edge is produced into a fairly long projection in the midradial line and is concave on either side of this. One of the radials bears a long rodlike tubercle, but the others are bare. Large well spaced tubercles on the division series and lower brachials are the most conspicuous feature of this animal, even to the naked eye. These tubercles stand out at right angles to the surface of the ossicles; most of them are rodlike, though some are flattened and bladelike. Their arrangement has an order that is not at first sight apparent. On the IBr_1 the middle point of the proximal border is raised into a blunt spine, a low knob, or a bigger lip. In front of and on either side of it in the proximal half of the ossicle stand two tubercles. There are usually two or three tubercles laterally, on each of the rounded sides. In most of the IBr_2 the proximal edge is produced outward into two small triangular lips, one on either side of the middle point; in front of and between these lips, in the midradial line, is a single strong tubercle. Along either side of the distal edge there are three to five tubercles. There may be additional lips or there may be tubercles along the lateral parts of the proximal edge, and there are usually two or three tubercles on each of the rounded sides. The greater part of the dorsal surface near the midradial line is free from tubercles.

The first brachials are roughly rectangular, more than half as long as broad, and are not incised by the second. They carry about five to eight tubercles, some placed in the proximal half, a few on the proximal edge itself, and the others on the rounded exterior side. The distal half of the dorsal surface, except for the exterior side, is usually free from tubercles. The second brachials are irregular in shape, wider distally than proximally, a little wider than long. The distal and outer edges are straight, the interior is oblique, and the narrow proximal edge is slightly rounded. The large tubercles lie along and near the proximal and distal edges, leaving the middle of the dorsal surface smooth. The hypozygal of the first syzygial pair is about twice as broad as long. There are large tubercles along the proximal edge, and there may be smaller tubercles along the distal edge.

P_1 is the only pinnule present, and only one of these is nearly complete. It is about 8 mm. long and is composed of 17 segments. The first segment is rounded, about as long as broad, with the dorsal edge raised distally into a low prominence. The segments immediately following are broader than long. The second bears two prominences dorsally and distally, one on each side, the inner (nearer the arm) being the larger. On the third to the fifth or sixth segments both prominences are considerably larger. The inner arises from the whole of the lateral edge as a high narrow ridge with the same long axis as the pinnule; on the fourth and fifth segments its crest may be indented so that it has two peaks. The outer prominence is not so long or so high; it arises from the distal third of the dorsolateral edge; its summit is rough with spines. The dorsal surface between the prominences is flat so that the general appearance of the dorsal surface of the proximal part of the pinnule is that of a flat-bottomed channel running between long and high prominences on the inner side and short and lower prominences on the outer. Between the sixth and ninth segments the long inner prominence decreases and becomes obliquely inclined to the dorsal surface, and finally passes into a lateral extension of it. At the same time the outer prominence rapidly decreases, to disappear at about the twelfth segment. The distal segments of the pinnule, as viewed from above, are broad and flat, considerably broader than long, and broader distally than proximally, the greater distal width being on the inner side.

The disk is very heavily plated.

Locality.—Northwest of Sokotra (lat. 14°20′ N., long. 52°30′ E.); 2,194 meters (1,200 fathoms); Capt. V. F. Sparks, cable repair ship *Electra*, July 1909 [A. H. Clark, 1911, 1912, 1913, 1937; John, 1937] (1, B. M.).

History.—During a visit to the British Museum in 1910 I found this species in a jar with new species of *Pachylometra* (*Perissometra*) and *Thaumatometra*, and recorded it as a new species of *Thalassometra* in 1911, 1912, 1913, and 1937. It was formally described by D. Dilwyn John in 1937.

THALASSOMETRA AGASSIZII (Hartlaub)

[See vol. 1, pt. 2, pl. 3, figs. 981–983, pl. 13, fig. 1050, pl. 14, fig. 1059, pl. 22, fig. 1140, pl. 27, figs. 1171, 1172.]

Antedon agassizii Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, pp. 129, 131 (description and detailed discussion; *Albatross* stations 3357, 3408, 3409), pl. 1, figs. 4, 7, 8, pl. 2, figs. 16, 18, 19, pl. 3, fig. 23, pl. 4, fig. 26.—H. L. Clark, Proc. Washington Acad. Sci., vol. 4, 1902, p. 522.—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, pp. 1578, 1580 (listed).

Thalassometra agassizi A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14 (listed).

Thalassometra agassizii A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 203 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 167 (in key; range), p. 170 (references).

Diagnostic features.—The elements of the division series and lower brachials are bordered proximally and distally with coarse blunt spines, with occasionally a few on the dorsal surface; and the cirri are arranged in 10 columns on the centrodorsal, each radial pair of columns with an additional cirrus between them near the rim of the centrodorsal. The 10–12 arms are about 175 mm. long, and the cirri are about 40 mm. long with 60+ segments.

Description.—The centrodorsal is of moderate size, dome-shaped with a bare dorsal pole which is beset with small spines. The cirrus sockets are arranged in three columns in each radial area, the two outer columns, which meet distally, of three, sometimes two, sockets, the central of one. The radial areas are separated by slight interradial ridges.

The cirri are XV–XXII, with up to 60+ segments, about 40 mm. long. They are slender, and in the outer half strongly compressed laterally. The first two segments are short, the third is longer, the fourth is about as long as the third, and the sixth is the longest, reaching 2.5 mm. in length. From this point the length of the segments rapidly decreases to about the twentieth, which is followed by a series of short segments which gradually decrease in size. In correlation with the decrease in size, the dorsal profile of the cirri becomes conspicuously serrate. Many cirri have on the last thirty segments a prominent spine. The opposing spine is feebly developed.

The radials are just visible. The IBr_1 are short, laterally entirely free, and are not incised by the axillaries with which they form slight tubercles. The IBr_2 (axillaries) are rhombic, distally strongly broadened, sometimes in close contact with their neighbors against which they are sharply flattened laterally. The elements of the IBr series are beset with short blunt spines (in the figure shown chiefly along the edges). Sometimes IIBr 2 series are present.

The 10–12 rounded and slender arms, which have a very uneven dorsal surface, are about 175 mm. long. The brachials as far as the second syzygy bear on the proximal and distal ends small blunt spines that stand out vertically from the dorsal surface, like the elements of the IBr series. The first brachials are moderately short, broadened in the proximal half and with sharply flattened outer sides which are appressed against those of the first brachials of the adjacent postradial series. These laterally flattened sides continue the lateral extensions of the axillaries and with them form an even surface. The first brachials are interiorly united in the proximal half. The second brachials are somewhat longer than the first and are distally broadened. Like the first syzygial pair they are in close contact with the corresponding ossicles of neighboring arms; since it is toward the ventral side this contact is difficult to see. The second brachials are separated from the first by a conspicuous synarthry. The seven brachials following the first syzygial pair are somewhat broader than long, and are centrally constricted. From about the ninth onward the length increases and the shape becomes more triangular, remaining so until between about the twentieth and thirtieth. From about the twenty-third brachial (length 2.5 mm.) onward the length again slowly increases. The triangular brachials are followed by others more trapezoidal in shape, and in the outer half of the arms the brachials become strongly overlapping. Their distal ends are strongly produced, and in the outer half of the arms finely spinous. From the distal ends longitudinal grooves run inward over the distal half of the brachials. The arms, which are composed of about 130 brachials, gradually decrease in thickness from the base outward.

Syzygies occur between brachials 3+4, again from between brachials 14+15 to between brachials 16+17, and distally at intervals of 3 or 4 muscular articulations.

P_1 is moderately stiff, 9–11 mm. long with 16–18 short smooth segments of which the first four—especially the first two—are broader than long. The pinnule is broad and laterally flattened at the base, after about the sixth segment tapering rapidly to a delicate tip. The segments in the proximal half are smooth, with the pinnule edge on the side toward the ambulacrum serrate; the distal segments have finely spinous distal borders; the second-fifth segments are carinate. The articulation between the earlier segments is less close than that between the outer segments, a feature more pronounced in the pinnules following, the basal segments of which have a somewhat different shape. These are also somewhat flattened, but this flattening comes to an end on the lower segments of P_3, which is rounded. P_a is about 2 mm. shorter than P_1 and is correspondingly weaker.

P_2 is shorter than P_1 and has somewhat fewer segments; it is also less stiff and markedly more slender. As on the pinnules following the component segments have finely spinous distal ends.

The succeeding pinnules decrease in length, the shortest being 6 mm. long, and become more slender with longer segments. After the fifteenth brachial the pinnules again increase in length, reaching a maximum of 23 mm. with 22–23 segments which are markedly longer than broad except for the first two, especially the first, which is short, broad, and trapezoidal.

The disk is 9 mm. in diameter, strongly incised and completely plated. The ambulacral surface of the arms and genital pinnules is prominently plated. Side plates occur on the pinnules. The sacculi are small and little evident, alternating with the side plates.

The color in alcohol is uniform greenish yellow, for the most part having been extracted by the similarly colored liquid.

Notes.—Hartlaub said that a small specimen with 11 arms from *Albatross* station 3408 is noteworthy in having the segments of P_1 with less smooth distal ends than usual; they are finely spiny as is the case only with the distal segments in the other specimens. From station 3408 there is also a smaller specimen with the arms 45 mm. long, and in addition there are two very small specimens in which the radials are wholly visible and are beset with blunt, short, erect spines.

Hartlaub said that a noteworthy feature of this new species, in addition to the variation in the number of arms, is the reduction of the interradial contact surfaces of the axillaries and first brachials, and the fact that such contact surfaces may be completely lacking. The IBr_1 are entirely free laterally, being in contact only through the lateral extensions of their broadened proximal ends. Between the contact point of their anterolateral angles and the contact of the lateral angles of the axillaries there is a considerable open space (water pore). Hartlaub pointed out that the same feature seems to occur in *Antedon* (*Thalassometra*) *multispina*, and that Carpenter here regarded it as a juvenile feature.

Noteworthy also, according to Hartlaub, is the size of this species which, with an expanse of 350 mm., exceeds almost all the other species in the *Basicurva* group. He said it was surpassed by *Antedon* (*Perissometra*) *flexilis* with an expanse of 550 mm., and by *A.* (*P.*) *robusta* with a spread of nearly 500 mm. In giving an expanse of 550 mm. (55 cm.) for *A.* (*P.*) *flexilis* Hartlaub was quoting Dr. P. H. Carpenter, but the 55 cm. given by Carpenter was an error for 35 cm.

Hartlaub remarked that in the spinosity of the IBr series and lower brachials there is a decided similarity between this species and *Antedon* (*Thalassometra*) *bispinosa* in which, judging from the figures, the elements of the IBr series and lowest brachials are beset with small blunt spines not only along the edges but also over their entire surface. In *Th. agassizii* this ornamentation runs farther out along the arm and the small quite erect spines are confined to the proximal and distal edges of the ossicles so that each articulation is marked by two transverse rows of spines.

Regarding the centrodorsal and the articular faces of the radials (see Part 2, pl. 3, figs. 981–983) Hartlaub said that the cirrus sockets are moderately large and show a conspicuous articular boss. The ventral surface of the centrodorsal is approximtely pentagonal, with the five angles somewhat prominent. The dorsal surface of the radial pentagon shows traces of a basal star. On the articular faces of the radials the muscular fossae are of about the same size as the interarticular ligament fossae, and have a smooth surface.

The ambulacral plating of the pinnules is composed, according to Hartlaub, of side- and covering-plates. The latter are fine-meshed approximately oval plates. They rest on the side plates and are apparently movable, since their position is variable. Sometimes they lie flat like imbricating tiles, and sometimes they are more raised. If they are viewed from below when in this position it is seen that they have an alternating oblique position in reference to the longitudinal axis of the arm. Their precise attachment was not determined by Hartlaub. They are exceedingly small, very brittle, and difficult to isolate. They are attached by ligaments that are not broken down by boiling for several minutes in caustic potash, and too long boiling in caustic destroys them. The side plates are arranged in a zigzag. On each side of the ambulacral groove they form a sort of Spanish wall. In the niches of this wall, more or less concealed, lie the sacculi. The produced angles are mostly formed by two apposed plates; in other places, for instance at the end of a pinnule, they appear to originate from breaking off from a single plate. The side plates are more wide-meshed than the covering plates and are often quadrangular with notched edges. In certain places one sees that through these regularly recurring notches two gaps are formed in the line of contact of their ends. The higher gap is occupied by a sacculus and through the lower a tentacle protrudes.

Localities.—*Albatross* station 3409; Galápagos Islands (lat. 0°18′40″ S., long. 90°34′00″ W.); 598 meters; bottom temperature 5.7° C.; black sand; April 3, 1891 [Hartlaub, 1895; H. L. Clark, 1902; A. H. Clark, 1907, 1909, 1912, 1918].

Albatross station 3408; Galápagos Islands (lat. 0°12′30″ S., long. 90°32′30″ W.); 1,250 meters; bottom temperature 4.2° C.; globigerina ooze; April 3, 1891 [Hartlaub, 1895; H. L. Clark, 1902; A. H. Clark, 1907, 1909, 1912, 1918].

Albatross station 3357; off Mariato Point, Panamá (lat. 6°35′00″ N., long. 81°44′00″ W.); 1,429 meters; bottom temperature 3.6° C.; green sand; February 24, 1891 [Hartlaub, 1895; H. L. Clark, 1902; A. H. Clark, 1907, 1909, 1912, 1918].

Geographical range.—From the Galápagos Islands to Panamá.

Bathymetrical range.—From 598 to 1,429 meters.

Thermal range.—From 3.6° to 5.7° C.

History.—*Antedon agassizii* was described and figured by Dr. Clemens Hartlaub in 1895 from specimens from *Albatross* stations 3408 and 3409 in the Galapágos Islands and station 3357 off Mariato Point, Panamá. Hartlaub did not give the number of specimens he had, but mentioned three from station 3408 that apparently were not included in the original description. He described and figured the centrodorsal and radial pentagon, and the side- and covering-plates, and discussed the relationships of the species in detail. Dr. Hubert Lyman Clark in 1902 listed *Antedon agassizii* among the echinoderms known from the Galápagos Islands.

In my revision of the genus *Antedon* published in 1907 *agassizii* was transferred to the new genus *Thalassometra*, and in my revision of the family Thalassometridae published in 1909 it was listed as *Thalassometra agassizii.* In my memoir on the crinoids of the Indian Ocean published in 1912 and again in my report on the unstalked crinoids of the *Siboga* expedition published in 1918 *Thalassometra agassizii* was listed and the synonymy and range were given; in the *Siboga* report *agassizii* was included in the key to the species of the genus *Thalassometra.*

THALASSOMETRA VILLOSA (A. H. Clark)

Plate 17, Figures 50–52

[See also vol. 1, pt. 1, figs. 95, p. 157, 197, 198, p. 237, 272, p. 259, 488, p. 365; pt. 2, figs. 71, p. 43, 323, p. 227, 350, p. 229, 823, p. 392, 879, 880, p. 435.]

Antedon villosa A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 138 (description; *Albatross* station 4780).

Thalassometra villosa A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed); Amer. Nat., vol. 42, No. 500, 1908, p. 542 (belongs to a group characteristic of the oceanic area); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (same); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14 (listed); Crinoids of the Indian Ocean, 1912, p. 203 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 167 (in key; range), p. 170 (references).

Diagnostic features.—The dorsal surface of the elements of the division series and lower brachials is studded with stout, well-spaced, sharply conical spines, and their borders are everted and crenulate, dentate, or serrate, but not conspicuously spiny; and the cirri are arranged in 15 crowded columns of 2 or 3 each on a rather large centrodorsal. The 10 or 11 arms are 95 mm. long, and the cirri are 33 mm. long with 40–50 (usually about 50) segments.

Description.—The centrodorsal is rather large, bluntly conical or more or less hemispherical, with the cirrus sockets in 15 crowded columns, 1, 2, or 3 to a column.

The cirri are XV–XLV (usually about XL), 40–50 (usually about 50), about 33 mm. long. The first three segments are short, the fourth is about as long as broad, and the following to the thirteenth or fourteenth are longer than broad, the seventh, which is the longest, being somewhat over twice as long as broad; distally the segments gradually become shorter. The earlier segments have their distal ends abruptly turned outward, while from about the tenth onward small blunt dorsal spines are developed which, however, never become especially prominent. The seventh is a transition segment with the proximal three-quarters of its surface dark in color and dull like that of the preceding segments, and the distal quarter lighter and more highly polished like the surface of the segments succeeding.

The disk is well plated, as are the brachial and pinnule ambulacra. The sacculi are small but numerous.

The ends of the basal rays are visible as small tubercles in the interradial angles of the calyx.

The radials are barely visible, crescentic in shape. The IBr_1 are short, about 3 times as broad as long. The IBr_2 are broadly pentagonal, broader than long; there is a rounded synarthrial tubercle on the articulation between these elements. The IIBr series are 2, resembling the IBr series but proportionately somewhat longer.

Arms 10, in one case 11, in number, 95 mm. long. The first 8 or 9 brachials are oblong, broader than long, with the edges strongly everted and bluntly spinous, the following very obliquely wedge-shaped, about as long as broad, with the distal edges somewhat produced, becoming more elongate distally with the distal edges overlapping and spinous and the dorsal surface finely striate. The elements of the IBr series (and of the IIBr series when present) and the first 2 brachials are bordered with a row of short spines or prominent tubercles, and their dorsal surface is thickly studded with spines; they are sharply flattened laterally and are in close lateral apposition.

Syzygies occur between brachials 3+4, again from between brachials 17+18 to between brachials 19+20, and distally at intervals of from 4 to 9 muscular articulations.

P_1 is 10 mm. long, enormously stout, tapering from the base to the tip, more rapidly in the distal portion, and is composed of 20 segments. P_2 is 7 mm. long with 15 segments, much more slender than P_1. The following pinnules are somewhat shorter, but increase again distally to 14 mm. The distal pinnules have the first segment short, broadly trapezoidal, the second trapezoidal but longer, the following to the middle of the pinnule about as long as broad, and the remainder elongate. All the pinnule segments have prominently everted spiny distal edges.

Locality.—*Albatross* station 4780; off Agattu Island, western Aleutians (lat. 52°01′00″ N., long. 174°39′00″ E.); 1,912 meters; bottom temperature 2.2° C.; gray mud, sand, and pebbles; June 7, 1906 [A. H. Clark, 1907, 1908, 1909, 1912, 1918] (5, U.S.N.M., 22630 [type], 35584, 36174).

History.—This species was described as *Antedon villosa* in 1907 from five specimens that had been dredged by the *Albatross* at station 4780, at the western end of the Aleutian Island chain, in the preceding year. In my revision of the genus *Antedon* published later in 1907 *Antedon villosa* was made the type of the new genus *Thalassometra.* In two papers published in 1908 *Thalassometra villosa* was said to belong to a group characteristic of the oceanic area. In my revision of the family Thalassometridae published in 1909 *Thalassometra villosa* was listed. In my memoir on the crinoids of the Indian Ocean published in 1912 and in my report on the unstalked crinoids of the *Siboga* expedition published in 1918 *Thalassometra villosa* was listed and the synonymy and locality were given; in the *Siboga* report *villosa* was included in the key to the species of the genus *Thalassometra.*

THALASSOMETRA ATTENUATA A. H. Clark

PLATE 17, FIGURES 53, 54

[See also vol. 1, pt. 2, figs. 523, 524, 527, 528, p. 283.]

Thalassometra attenuata A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 147 (description; 22°24′ 00″ N., 66°51′ 30″ E.; 765 fathoms); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 553 (compared with *Th. hirsuta*); Crinoids of the Indian Ocean, 1912, p. 204 (synonymy; detailed description; locality), fig. 38, p. 205; Smithsonian Misc. Coll., vol. 60, No. 15, 1913, p. 46 (compared with *Th. pergracilis* [*gracilis*]); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 168 (in key; range), p. 171 (references); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 654 (off Mozambique; 500 fathoms).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 22.—A. H. CLARK, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936 (Jan. 1, 1937), p. 87 (listed), p. 93 (*Mabahiss* station 143; notes; range), pp. 101, 104.

Diagnostic features.—The elements of the division series and lower brachials are smooth dorsally, or bear a few low inconspicuous tubercles; the synarthrial tubercles are rather prominent, but there is no median carination; and the cirri are arranged in 10 definite columns on the centrodorsal. The 10–13 arms are 80–120 mm. long, and the cirri are 50 mm. long with 62–71 segments.

Description.—The centrodorsal is conical with the sides slightly convex, 3 mm. broad at the base and 2 mm. high. The cirrus sockets are arranged in 10 columns of usually 2 each, the radial pairs of columns being usually slightly separated in the midradial line by a shallow furrow or a coarsely tubercular ridge.

The cirri are XX, 62–71, 50 mm. long, elongated and very slender. The longest proximal segments are twice as long as broad or slightly longer, and the twenty-fifth and following are slightly broader than long. The segments after the seventeenth–twentieth have the distal dorsal edge produced into a serrate ridge that soon gives place to small carinate dorsal spines.

The ends of the basal rays are visible as small, though rather prominent, tubercles in the interradial angles.

The radials are entirely concealed by the centrodorsal, or are just visible beyond its rim, sometimes bearing on the dorsal surface a row of small tubercles. The IBr_1 are very short, widely chevron-shaped, with the proximal edge and the lateral thirds of the distal edge somewhat everted, and the distal lateral angles more or less produced. The IBr_2 (axillaries) are triangular, twice as broad as long with the anterior edges somewhat everted and the lateral angles more or less produced. The IIBr series, when present, are 4(3+4); they are developed in two of the six specimens in the type series. The elements of the IBr series and first two brachials are smooth dorsally or bear a few low inconspicuous tubercles; their lateral borders are usually slightly spinous; the synarthrial tubercles are rather prominent. The lateral edges of the elements of the IIBr series are more or less produced.

The 10–13 arms are from 80 to 90 mm. long. They are exceedingly slender, having in general more the appearance of the arms of some slender antedonid than of those of a thalassometrid. The first brachials are short, wedge-shaped, twice as long exteriorly as interiorly, basally united interiorly, with the anterior and posterior edges slightly thickened, the lateral edges somewhat produced, and the anterolateral angles, both interior and exterior, more or less produced. The second brachials are similar in size and shape. The first syzygial pair (composed of brachials 3+4) is usually slightly longer interiorly than exteriorly, from half again to about as broad as long. The next three or four brachials are approximately oblong, twice as broad as long, and those following become triangular, as long as broad, distally slowly increasing in length and becoming wedge-shaped, being twice as long as broad in the outer part of the arms. The brachials beyond the second have the dorsal surface studded with very fine short spines or sharp tubercles which in some individuals are nearly obsolete. At about the end of the proximal fourth of the arm the brachials begin to develop prominent longitudinal striations which increase in frequency and in height distally. The proximal oblong brachials have the proximal and distal ends somewhat prominent. After about the twentieth brachial the distal edges begin to overlap, and in the distal portion of the arms the brachials have the distal part somewhat expanded and the central part somewhat constricted so that the outer portions of the arms closely resemble those of the species of Antedonidae.

The pinnules are essentially as in the related species; the three lowest pinnules on either side of the arm are very strongly carinate.

The color in alcohol is white, the perisome, and sometimes the IBr series and arm bases, light brownish.

Notes.—The arms of the specimen from *Mabahiss* station 143 were probably about 120 mm. long. The cirri are about 45 mm. long and consist of 55 segments of which the ninth is a transition segment. The interradial pairs of columns of cirrus segments are narrow and are widely separated by a broad midradial deeply concave bare area.

Localities.—*Investigator;* south of Kurrachi (lat. 22°24′00″ N., long. 66°51′30″ E.); 1,398 meters; bottom temperature 6.0° C.; green mud [A. H. Clark, 1909, 1911, 1912, 1913, 1918, 1937; Gislén, 1934] (6, U.S.N.M., 35591; I. M.).

Mabahiss station 143; in the vicinity of the Maldive Islands (from lat. 5°15′48″ N., long. 73°22′48″ E. to lat. 5°13′42″ N., long. 73°23′36″ E.); 797 meters; temperature (at 770 meters) 7.88° C.; gray sand; March 30, 1934 [A. H. Clark, 1937] (1, B. M.).

Off Mozambique (lat. 16°48′ S., long. 39°40′ E.); 914 meters; from a cable; cable repair ship *Lady Denison-Pender*, Eastern and Associated Telegraph Co. [A. H. Clark, 1929] (1, B. M.).

Geographical range.—From off Kurrachi to the Maldive Islands and southwestward to the coast of Mozambique.

Bathymetrical range.—From 797 to 1,398 meters.

Thermal range.—From 6.0° to about 7.88° C.

History.—*Thalassometra attenuata* was described in 1909 from 6 specimens dredged off Kurrachi in 765 fathoms by the Royal Indian Marine Survey steamer *Investigator.* In 1911 it was compared with the new species *Th. hirsuta*, and in 1912 in my memoir on the crinoids of the Indian Ocean it was redescribed and figured. In 1913 I compared it with the type series of Carpenter's *Antedon gracilis.* In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *attenuata* was included in the key to the species of *Thalassometra* and the synonymy and range were given. In 1929 I recorded a specimen from off Mozambique in 500 fathoms that had been taken from a cable brought to the surface by the cable repair ship *Lady Denison-Pender* of the Eastern and Associated Telegraph Co. In 1934 Prof. Torsten Gislén discussed certain features of the structure. In 1936 I recorded and gave notes on a specimen from the John Murray Expedition to the Indian Ocean, 1933–34, that had been dredged by His Egyptian Majesty's steamer *Mabahiss* at station 143 in the Maldive region in 797 meters.

THALASSOMETRA HIRSUTA A. H. Clark

PLATE 18, FIGURE 59

Thalassometra hirsuta A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 552 (description; *Albatross* station 5445; also stations 5275, 5474); Zool. Anz., vol. 39, No. 11/12, 1912, p. 426 (compared with *Th. margaritifera*); Crinoids of the Indian Ocean, 1912, p. 206 (synonymy; range); Unstalked crinoids of the *Siboga*-Exped., 1918, p.168 (in key; range), p. 169 (references; notes; stations 85, 286), pp. 272, 275 (listed).—GISLÉN, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 7 (probably the same as *Th. gracilis* and *Th. pubescens*).

Diagnostic features.—The elements of the division series and lower brachials have the edges all around strongly everted and coarsely spinous, with a coarsely spinous median carination and a few coarse spines scattered over the dorsal surface; and the cirri are arranged in 10 definite columns on the centrodorsal. There are 10 arms, and the cirri are 30–45 mm. long with 48–66 (usually 54–66) segments.

Description.—The centrodorsal is low-conical, with the dorsal pole finely papillose. The cirrus sockets are arranged in 10 columns of two or three each, the two columns in each radial area being slightly separated proximally by a narrowly linear or wedge-shaped papillose area.

The cirri are slender, XV–XXV, 48–66 (usually 54–66), from 30 to 50 mm. long. The first segment is short, those following increasing in length and becoming about as long as, or slightly longer than, broad on the fourth; the fifth or sixth is a transition segment, about three times as long as broad. The segment following is nearly as long, those succeeding gradually decreasing in length, those in the distal portion of the cirri being somewhat broader than long. After the transition segment the distal dorsal edge slowly becomes produced, the short outer segments bearing rather low blunt spines.

The radials are concealed by the centrodorsal. The IBr_1 are very narrow and crescentic with the edges all around strongly everted and coarsely spinous, with a coarsely spinous median carination, and a few coarse spines scattered over the dorsal surface. The IBr_2 (axillaries) are rhombic, twice as broad as long, with the edges all around strongly everted and coarsely spinous, with a coarsely spinous median carination in the proximal two-thirds, and with coarse spines scattered irregularly over the dorsal surface.

There are 10 arms. The first brachials are short, slightly wedge-shaped, three or four times as broad as long exteriorly, with the edges all around strongly everted and coarsely spinous, the dorsal surface more or less covered with rather long spines, and with a coarsely spinous median keel. The second brachials are slightly larger and more obliquely wedge-shaped. The first syzygial pair (composed of brachials 3+4) is oblong, from half again to nearly twice as broad as long. The following four brachials are approximately oblong, twice as broad as long, those succeeding becoming triangular, as long as broad, and farther out wedge-shaped and somewhat longer than broad, and elongate terminally. The third–eighth brachials have strongly everted and spinous ends, and the dorsal surface very thickly covered with rather long fine spines; the median carination seen on the elements of the IBr series and on the first two brachials may be faintly suggested on the third and fourth, but extends no farther. As the brachials become triangular the dorsal spinosity becomes shorter and finer and less evident, the proximal ends of the brachials become less everted and the distal more so, this distal eversion, leaning gradually forward, becoming a spinous overlap, which is fairly prominent distally. At the same time the dorsal surface of the brachials becomes marked by numerous fine, sharp, longitudinal ridges, most prominent distally. In the outer part of the arm the distal part of these ridges breaks up into numerous thickly set anteriorly directed spines.

Notes.—A specimen from *Siboga* station 85 may be described as follows: The centrodorsal is small, low, rounded conical; the dorsal pole is thickly studded with small more or less sharpened papillae. The cirrus sockets are arranged in 10 closely crowded columns of two sockets each.

The cirri are XX, 60–64, from 40 to 45 mm. long. The longest proximal cirrus segments are from two-and-one-half to three times as long as broad; the eversion of the distal edges of the segments begins on the fifth or sixth.

The dorsal surface of the ossicles of the IBr series and first two brachials is uniformly and rather thickly covered with short fine spines, and their proximal and distal edges are everted and armed with very numerous fine spines, which are more closely set and longer than those on the dorsal surface. The IBr_1 and the proximal half of the IBr_2 (axillary) bear a moderately sharp, though low, median keel which is studded with slender spines; more or less complete reduplications of this keel occur on the first two brachials. Beyond the first syzygy the spines become finer, shorter, more thickly set, and more evenly distributed, gradually giving way to finely serrate longitudinal striations as the ends of the brachials become oblique.

The base of the animal is moderately compact, the outer edges of the elements of the IBr series and lower brachials being straight and in close apposition. Rather small water pores are present.

The specimen from *Siboga* station 286 is slightly smaller and more slender than the preceding, with the spinosity of the IBr series and first two brachials very slightly finer and thicker. The arms are 80 mm. long, and the cirri are 27 mm. long with 44–51 segments.

In the original description I said that this form is nearest *Thalassometra attenuata*, but it is stouter than that species with shorter and somewhat stouter cirri which usually have fewer segments. It differs markedly, however, in the great development of spines on the division series and arm bases, these parts in *Th. attenuata* being comparatively smooth.

Gislén suggested that *hirsuta* is probably synonymous with *gracilis* and *pubescens*.

Localities.—Albatross station 5474; China Sea, in the vicinity of southern Luzon; Malavatuan Island (N.) bearing S. 73°30′ E., 17.5 miles distant (lat. 13°57′30″ N., long. 120°03′25″ E.); 960 meters; bottom temperature 5.1° C.; gray mud and sand; July 16, 1908 [A. H. Clark, 1911, 1912, 1918; Gislén, 1928] (1, U.S.N.M., 35587).

Albatross station 5275; China Sea in the vicinity of southern Luzon; Malavatuan Island (N.) bearing S. 71° E., 10.75 miles distant (lat. 13°55′55″ N., long. 120°10′15″ E.); 214 meters; fine sand; July 16, 1908 [A. H. Clark, 1911, 1912, 1918; Gislén, 1928] (1, U.S.N.M., 35589).

Albatross station 5445; east coast of Luzon; Atalaya Point, Batag Island, bearing S. 56° E., 5.3 miles distant (lat. 12°44′42″ N., long. 124°59′30″ E.); 700 meters; bottom temperature 6.8° C.; green mud and sand; June 3, 1909 [A. H. Clark, 1911, 1912, 1918; Gislén, 1928] (4, U.S.N.M., 27500 [type], 35588).

Siboga station 85; Makassar Strait (lat. 0°36′30″ S., long. 119°29′30″ E.); 724 meters; fine gray mud; June 17, 1899 [A. H. Clark, 1918] (7, U.S.N.M., E. 407; Amsterdam Mus.).

Siboga station 286; Timor Sea (lat. 8°50′12″ S., long. 127°02′12″ E.); 883 meters; mud, evidently a thin layer; January 19, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Geographical range.—From the Timor Sea northward to Luzon, Philippine Islands.

Bathymetrical range.—From 214 to 960 meters; the average of 5 records is 696 meters.

Thermal range.—From 5.1° to 6.8° C.

Bottom.—Mud, mud and sand, or fine sand.

History.—Thalassometra hirsuta was described in 1911 from a specimen from *Albatross* station 5445; at the same time three other specimens were recorded from this station, and one each from stations 5275 and 5474. In my memoir on the crinoids of the Indian Ocean published in 1912 this species was listed and the range and synonymy were given. In my memoir on the recent crinoids of the *Siboga* expedition published in 1918 seven specimens were recorded from station 85 and one from station 286 and notes on these were given. In 1928 Prof. Torsten Gislén suggested that *hirsuta* might be a synonym of Carpenter's *Antedon gracilis*.

THALASSOMETRA MARGARITIFERA A. H. Clark

PLATE 17, FIGURE 55

Thalassometra margaritifera A. H. CLARK, Zool. Anz., vol. 39, No. 11/12, 1912, p. 426 (description; *Siboga* station 45); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 169 (in key; range; references; description; station 45), p. 271 (listed), pl. 22, fig. 58.

Diagnostic features.—The elements of the division series and lower brachials have the edges less strongly everted than in *Th. hirsuta* with the spinosity coarser, the spines more uniform in size and more thickly distributed over the dorsal surface of the ossicles, also larger so that there is less difference between the spines of the dorsal surface and those of the everted edges; the median carination is more rounded and is studded with spines resembling those of the dorsal surface; and the cirri are arranged in 10 definite columns on the centrodorsal. The 10 arms are about 95 mm. long, and the cirri are 45 mm. long with 57+ segments.

Description.—The cirri are about 45 mm. long with somewhat more than 57 segments.

The 10 arms are about 95 mm. long.

This species is very closely related to *Th. hirsuta*. The eversion of the proximal and distal edges of the elements of the IBr series and of the first two brachials is less marked than in *Th. hirsuta*, and the spinosity is coarser, the spines being more uniform in size and more thickly distributed over the dorsal surface of the segments; they are also longer so that there is less difference between the spines of the dorsal surface and those of the everted edges. The median carination is more rounded than that of *Th. hirsuta*, and is studded with spines resembling those of the general dorsal surface.

Locality.—*Siboga* station 45; eastern Flores Sea, north of the eastern end of Sumbawa (lat. 7°24′00″ S., long. 118°15′12″ E.); 794 meters; fine gray mud with some radiolarians; April 6, 1899 [A. H. Clark, 1912, 1918] (2, Amsterdam Mus.).

History.—*Thalassometra margaritifera* was described in 1912 from two specimens dredged by the *Siboga* at station 45, and was redescribed and figured in 1918.

THALASSOMETRA MARGINATA A. H. Clark

[See vol. 1, pt. 1, fig. 96, p. 159.]

Thalassometra marginata A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 206 (detailed description; *Investigator* station 218); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 167 (in key; range), p. 170 (references); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 654 (Nicobar Islands; notes).

Diagnostic features.—The elements of the division series and first two brachials have the proximal and distal edges prominently everted and irregularly and coarsely dentate, the dentations with numerous fine spines on their tips, and the lateral borders perfectly plain, without spines or tubercles, and sharply, though narrowly, flattened against their neighbors; and the cirri are arranged in 10 definite columns on the centrodorsal. There are 10 arms, and the cirri are 40 mm. long with 34–46 segments.

Description.—The centrodorsal is truncated conical with the sides slightly convex, 3.5 mm. broad at the base, 1.5 mm. broad at the dorsal pole, and 2.5 mm. long interradially; the dorsal pole is covered with long coarse tubercles. The cirrus sockets are arranged in 10 columns of 2 each which are in close lateral contact interradially but are separated in the midradial line by an irregularly wedge-shaped smooth area which at its base (proximally) is not quite so wide as a single cirrus socket, from this point gradually narrowing and disappearing between the distal sockets, which are nearly or quite in apposition.

The cirri are XX, 34–46, about 40 mm. long, and moderately stout. The longest proximal segment is from two to two and one-half times as long as broad; the sixth or seventh is a transition segment.

The ends of the basal rays are visible in the interradial angles. Shallow and broad subradial clefts are present.

The IBr_1 are short, about four and one half times as broad as long, with the proximal and distal edges prominently everted and armed with about 6 or 8 irregular coarse dentations which have numerous fine spines at their tips. The IBr_2 (axillaries) are roughly rhombic with the lateral angles truncated and all the sides concave; the lateral edges are nearly as long as those of the IBr_1; the proximal and distal edges are everted, the proximal resembling the distal edges of the IBr_1, the distal with a more regular finely spinous margin. The elements of the IBr series are in close lateral apposition and sharply, though narrowly, flattened against their neighbors; their lateral edges are perfectly plain, without spines or tubercles.

The 10 arms are all broken off at the first syzygy between brachials 3+4. In shape the brachials resemble those of other species of the genus. They are perfectly smooth, with no trace of spines or of median carination. The proximal and distal edges are slightly thickened and everted, with a few small spines or tubercles.

Notes.—The preceding description is based upon a single very fragmentary specimen from *Investigator* station 218. This species is related to *Th. hawaiiensis* and to *Th. hirsuta.* From the former it differs in the much smaller centrodorsal, in the smaller number of cirrus segments of which the proximal are much longer, in the shorter ossicles of the IBr series which are in close lateral contact without intervening interradial water pores, and in the eversion of the edges of the ossicles of the IBr series and of the earlier brachials, these in *Th. hawaiiensis* being armed with large coarse blunt scattered spines, though not as a whole turned outward. There are no spines on the dorsal surface of the ossicles in *Th. marginata* such as occur, though sparingly, in *Th. hawaiiensis.* From *Th. hirsuta* this species differs in the very large and coarse instead of fine tubercles on the dorsal pole of the centrodorsal, in the smoothness of the wedge-shaped area separating the columns of cirrus sockets proximally, in the fewer cirrus segments of which the longest are somewhat shorter, in the much less, and more coarsely, spinous edges of the ossicles, and in the entire absence of a median carination and of spines on the dorsal surface of the elements of the IBr series and lower brachials.

The specimen from the Nicobar Islands is young with 10 arms 35 mm. long.

Localities.—*Investigator* station 218; Maldive Islands; 384 meters [A. H. Clark, 1912, 1918] (1, I. M.).

Nicobar Islands (lat. 7°52′38″ N., long. 92°59′13″ E.); cable repair ship *Patrol,* Eastern and Associated Telegraph Co. [A. H. Clark, 1929] (1, B. M.).

History.—*Thalassometra marginata* was first described in my memoir on the crinoids of the Indian Ocean published in 1912 on the basis of a much mutilated individual that had been dredged by the Royal Indian Marine Survey steamer *Investigator* among the Maldive Islands in 210 fathoms. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 this species was included in the key to the species of *Thalassometra*, and the synonymy and range were given. In 1929 I recorded a small specimen that had been found on a cable brought to the surface from an unrecorded depth by the cable repair ship *Patrol*, of the Eastern and Associated Telegraph Co.

THALASSOMETRA HAWAIIENSIS (A. H. Clark)

[See vol. 1, pt. 1, figs. 195, 196, p. 237; pt. 2, fig. 223, p. 175.]

Antedon hawaiiensis A, H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 152 (description; *Albatross* station 3475).

Thalassometra hawaiiensis A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 222 (*Albatross* stations 3475, 3476); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14 (listed); Crinoids of the Indian Ocean, 1912, p. 203 (locality); Die Crinoïden der Antarktis, 1915, p. 124 (shows characteristic features of *Anthometra adriani*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 168 (in key; range), p. 170 (references); Bernice P. Bishop Mus. Bull. 195, 1949, p. 74 (*Albatross* stations 3475, 3476), p. 87 (station data).

Diagnostic features.—The elements of the division series and first two brachials are bordered with thickly set spines; the triangular proximal brachials have projecting distal edges which increase in prominence distally, in the distal third of the arms becoming long curved overlapping spines; and the cirri are arranged in 10 definite columns on the centrodorsal. The 10–12 (usually 10) arms are 110 mm. long, and the cirri are 32 mm. long with 50–55 segments.

Description.—The centrodorsal is large, hemispherical or short columnar. The cirrus sockets are arranged in 10 columns of 1 or 2 each, and the columns are segregated into 5 radial pairs, each pair being separated from its neighbors on either side by a shallow groove, which is about as broad as the transverse diameter of a cirrus socket.

The cirri are XX, 50–55, 32 mm. in length. The first 3 segments are short, the fourth is about as long as broad, and those following increase in length to the seventh, which is the longest, about twice as long as broad. The succeeding segments decrease in length, becoming broader than long after the thirteenth and very short distally. Carinate dorsal spines begin to appear at about the tenth segment, and become very prominent distally. The first six segments and the proximal three-quarters of the seventh are dull yellowish, with a dull surface; the distal quarter of the seventh and the succeeding segments are white and highly polished. In lateral view the cirri taper gradually from the base to the middle of the seventh segment, remaining uniform in width from that point onward.

The disk, brachial and pinnule ambulacra are bordered with remarkably well developed plates. Sacculi are fairly well developed.

The ends of the basal rays are visible as small tubercles in the interradial angles of the calyx.

The radials are just visible beyond the rim of the centrodorsal, appearing crescentic in shape. The IBr_1 are more than twice as broad as long, with the distal border incised by the rounded proximal extension of the axillary. The IBr_2 (axillaries) are rhombic about half again as broad as long. The junction between the two elements of the IBr series rises into a slight tubercle. The IIBr series, when present, are 4(3+4). The IBr_1, $IIBr_1$ and first two brachials are bordered all around with thickly set spines. The division series and proximal brachials are in close lateral apposition and are sharply flattened laterally.

The arms are 10–12 (usually 10) in number, 110 mm. in length. The first 6 brachials are oblong, broader than long, and those following are triangular, about as long as broad, becoming wedge-shaped and longer distally. The triangular lower brachials have projecting distal edges which increase in prominence distally, becoming in the distal third of the arm long curved overlapping spines.

Syzygies occur between brachials 3+4, again at about brachials 21+22, and distally at intervals of from 3 to 5 muscular articulations. Following a IIBr series brachials 1+2 are united by syzygy.

P_1 is 6 mm. long, very stout basally but tapering rapidly after the seventh or eighth segment, strongly prismatic, sharply flattened exteriorly, and often more or less carinate. It is composed of about 12 segments which are very short basally, but become longer than broad terminally. P_2 and the following pinnules are shorter and much more slender, and are composed of fewer segments, which are somewhat longer than broad. The distal pinnules are about 10 mm. long, slender, the first 2 segments expanded and trapezoidal, the remainder about twice as long as broad, becoming more elongate distally.

The color in alcohol is white, with the division series and the first 2 brachials dark brown.

Localities.—*Albatross* station 3475; off Oahu, Hawaiian Islands (lat. 21°08′00″ N., long. 157°43′00″ W.); 642 meters; fine white sand; December 6, 1891 [A. H. Clark, 1907, 1908, 1909, 1912, 1915, 1918] (3, U.S.N.M., 22653, 35586)

Albatross station 3476; off Oahu, Hawaiian Islands (lat. 21′09′00″ N., long. 157°53′00″ W.); 545 meters; fine white sand; December 6, 1891 [A. H. Clark, 1908, 1909, 1912, 1915, 1918] (1, U.S.N.M., 35585).

History.—This species is as yet known only from the four specimens collected by the *Albatross* in 1891.

THALASSOMETRA LATIPINNA (P. H. Carpenter)

Antedon latipinna P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 116 (description; *Challenger* station 232), pl. 10, fig. 3.—Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (systematic and bathymetrical relationships).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 129 (comparison, in key, with *A. pubescens*).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 18 (not placed in a revision of the Thlassometridae); Crinoids of the Indian Ocean, 1912, p. 33 (of P. H. Carpenter, 1888=*Thalassometra latipinna*).

Thalassometra latipinna A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 318 (Japan); Crinoids of the Indian Ocean, 1912, p. 208 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 46 (published reference to specimen in the B. M.; *Challenger* station 232; characters of the division series and lower brachials); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 167 (in key; range), p. 170 (references).

Diagnostic features.—The elements of the division series and first two brachials have the edges finely spinous; the distal edges of the brachials are not produced; and the cirri are arranged in 10 definite columns on the centrodorsal. The 10 arms are 40 mm. long, and the cirri are 30 mm. long with 40 segments.

Description.—The centrodorsal is truncated conical, about 3 mm. broad at the base, 1.7 mm. across the flat dorsal pole, and 3 mm. high. The cirrus sockets are arranged in 10 apparently evenly spaced columns of 2 each.

The cirri are XX, 40; the longest proximal cirrus segments are nearly twice as long as broad, and those in the distal half of the cirri are broader than long and overlap dorsally so as to develop a sharp spinous keel.

The radials are partially visible as narrow bands beyond the rim of the centrodorsal. The IBr_1 are short and oblong, rather convex in the middle of the dorsal surface. The IBr_2 (axillaries) are rhombic, with the lateral angles truncated so as to form sides nearly as long as the sides of the IBr_1, and are about twice as broad as long. The elements of the IBr series, the first two brachials, and the hypozygal of the first syzygial pair have straight lateral edges, and small portions of their outer sides are flattened. The edges of the elements of the IBr series are finely spinous.

The 10 arms are probably about 40 mm. long and are composed of short quadrate brachials which, as far as they are preserved, are finely spinous on the dorsal surface.

Syzygies occur between brachials 3+4 and 13+14 and distally at intervals of 8–10 muscular articulations.

P_1 is short and stout with about 15 segments of which the lowest are short, wide, and slightly carinate, but not flattened laterally. The pinnules following diminish in size to about the third pair (P_3 and P_c) and then gradually increase in length, the segments becoming elongated.

The disk is about 4 mm. in diameter and is much incised and well plated. Side plates are fairly distinct on the pinnule ambulacra. Sacculi are apparently absent.

The color in alcohol is light brownish white.

The preceding description is adapted from the original description by Carpenter with a few additions from his figure and from notes which I made after an examination of the type specimen in London.

Locality.—*Challenger* station 232; Sagami Bay, Japan (lat. 35°11′ N., long. 139°28′ E.); 631 meters; bottom temperature 5.0° C.; green mud; May 12, 1875 [P. H. Carpenter, 1888; Hartlaub, 1895; A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1915, 1918] (1, B. M.).

History.—In his report on the comatulids of the *Challenger* expedition published in 1888 Dr. P. H. Carpenter described and figured this species under the name *Antedon latipinna* on the basis of a single mutilated specimen from station 232 in 345 fathoms. In 1895 Dr. Clemens Hartlaub discussed the systematic and bathymetrical relationships of *Antedon latipinna*, and in 1907 I compared it, by insertion in a key, with a new species, *A. pubescens.*

In my revision of the genus *Antedon* published later in 1907 *latipinna* was referred to the new genus *Thalassometra*, and in 1908 *Thalassometra latipinna* was listed as one of the crinoids of Japan. In my revision of the family Thalassometridae published in 1909 *Antedon latipinna* was listed among the species I was unable to place satisfactorily. In my memoir on the crinoids of the Indian Ocean published in 1912 *Thalassometra latipinna* was listed and the synonymy and range were given. In 1913 I published a note on the type specimen which I had examined at the British Museum in 1910, and in 1915 I discussed the range and its significance. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *latipinna* was included in a key to the species of *Thalassometra*, and the synonymy and range were given.

THALASSOMETRA GRACILIS (P. H. Carpenter)

[See vol. 1, pt. 1, fig. 363, p. 297; pt. 2, figs. 224, p. 177, 317, p. 227, 338, p. 229.]

Antedon gracilis P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 107 (description; *Challenger* station 214), pl. 12, figs. 3–5, pl. 15, figs. 1–4.—HARTLAUB, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (systematic and bathymetrical relationships).—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 474 (not *Solanocrinus gracilis* Goldfuss; renamed *A. pergracilis*); Crinoids of the Indian Ocean, 1912, p. 33 (of P. H. Carpenter, 1888=*Thalassometra pergracilis*).—GISLÉN, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 7.

Antedon pubescens A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 139 (description; *Albatross* station 4919).

Antedon pergracilis A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360, footnote (new name for *A. gracilis* P. H. Carpenter, not *Solanocrinus gracilis* Goldfuss); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 474 (same).

Thalassometra pergracilis A. H. CLARK, Smithsonian Misc. Coll., vol. 50, p. 3, 1907, p. 360 (listed; new name for *Antedon gracilis*, preoccupied); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14 (listed); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 147 (compared with *Th. attenuata*); Zool. Anz., vol. 39, 1912, p. 426 (compared with *Th. perplexa*); Crinoids of the Indian Ocean, 1912, p. 33 (=*Antedon gracilis* P. H. Carpenter, 1888), p. 207 (synonymy; about 30 miles west of Middle Andaman; about 485 fathoms; characters; summary of previous records); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 46 (published reference to specimens in B. M.; *Challenger* station 214; compared with *Th. attenuata*); Unstalked crinoids of the *Siboga-Exped.*, 1918, p. 167 (in key; range), p. 170 (references; record from the Andaman Islands not this species).—GISLÉN, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 7 (comments).

Thalassometra pubescens A. H. CLARK, Smithsonian Misc. Coll., vol. 50, p. 3, 1907, p. 360 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 318 (southern Japan); Amer. Nat., vol. 42, No. 500, 1908, p. 542 (belongs to a group characteristic of the oceanic area); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (same); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14 (listed); Crinoids of the Indian Ocean, 1912, p. 207 (synonymy; locality); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 168 (in key; range), p. 170 (references).—GISLÉN, Ark. Zool., vol. 19A, No. 32, Feb. 20, 1928, p. 7 (probably synonymous with *gracilis* and *hirsuta*).

Thalassometra gracilis GISLÉN, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 7, No. 25 (notes and comments).

Diagnostic features.—The elements of the division series and the lower brachials have the dorsal surface thickly beset with very fine spines; and the cirri are arranged in 10 definite columns on the centrodorsal. The 10 arms are 60–80 mm. long, and the cirri are 30 mm. long with 50–55 segments.

Description.—The centrodorsal is a low hemisphere with a roughened dorsal pole. The cirrus sockets are arranged in 10 columns, 2 in each radial area (Gislén).

The cirri are about XX, 50–55, reaching 30 mm. in length; a few of the segments are longer than broad, and the remainder are shorter and begin to overlap dorsally so as gradually to develop a sharp spinous keel.

The radials are scarcely visible. The IBr_1 are short and sharply convex in the middorsal line. The IBr_2 (axillaries) are broadly hexagonal. The elements of the IBr series and first two brachials are slightly carinate and are more-or-less fringed with small spines. They are also somewhat "wall-sided" with straight lateral edges that extend to the hypozygal of the first syzygial pair. According to Gislén they cannot be described as "very sharply flattened against each other."

The 10 arms are about 60 mm. long. They consist of elongately quadrate brachials of which the outer overlap a little. The dorsal surface of the arms is spiny (Gislén).

Syzygies occur between brachials 3+4, again between about brachials 14+15, and thence at very irregular intervals.

P_1 is relatively large with about 20 segments of which the lowest are broad with strong dorsal keels and flattened outer sides. P_a is similar but rather smaller. P_2 and P_b are much smaller and are but slightly carinate. The pinnules following increase slowly in length and at about the twentieth brachial they become boat-shaped at the base owing to the expansion of the third and next few segments.

The disk is 6 mm. in diameter, rather incised and much plated, as are also the lower parts of the arms. The pinnule ambulacra have fairly well developed side plates, but the sacculi are small and rare.

The color in alcohol is brownish white.

Notes.—The preceding description is adapted from that of Carpenter, with a few additions by Gislén. This is a slender species, about the build of *Th. attenuata* though more robust basally.

Carpenter called attention to the fact that in this species P_a is of the same type as P_1, smaller in size but with similarly carinate lower segments which are flattened on the outer side. He said that the fringe of small spines on the elements of the IBr series and lower brachials rather obscures their straight-edge and wall-sided character, though this is very distinct in the smoother individuals, and the lateral flattening of the basal segments in P_1 indicates the position of the type very clearly.

He said that the pinnules beyond the twentieth brachial until near the end of the arms are remarkable for the character of the third and following segments which are widely V-shaped in cross section so that the lower part of the pinnule has a boat-shaped appearance when seen from the dorsal side. This expanded portion of the pinnule encloses the gonad, and according to Carpenter recalls on a smaller scale a similar arrangement in the pinnules of *Hyocrinus*. The enlargement of the lower segments of the pinnules gradually disappears toward the ends of the arms and there is no indication of it in the pinnules of the youngest individual obtained.

This young individual shows much more of the radials externally than is visible in the adults, while P_a shows hardly any trace of the enlarged and carinate basal segments which appear in the adults.

A specimen from *Albatross* station 4919, which does not appear to differ in any tangible features from Carpenter's *Antedon gracilis*, was described as a new species under the name of *Antedon pubescens*. Its characters are as follows:

The centrodorsal is rather small, bluntly conical. The cirrus sockets are arranged in 10 columns of usually three each.

The cirri are XXV–XXX, 50–55, slender, 30 mm. long. The proximal 10 or 12 segments beyond the basal are longer than broad, and the distal are broader than long and develop rather low dorsal spines.

The ends of the basal rays are just visible in the interradial angles of the calyx as small tubercles.

The radials are visible in the interradial angles over the ends of the basal rays. The IBr_1 are short and bandlike, sharply carinate, with raised and serrate edges. The IBr_2 (axillaries) are low and broad with a sharp keel in the proximal half.

The 10 arms are 80 mm. long. The first 6 or 7 brachials are oblong, those following wedge-shaped, becoming elongate distally. The elements of the IBr series and lower brachials are covered with numerous and thick-set very fine spines which become less apparent after about the tenth brachial, at which point the brachials develop an overlapping border of very fine teeth and longitudinal striations, the latter on the distal brachials becoming more pronounced and on the outer portion of the brachials breaking up into numerous fine spines.

Syzygies occur between brachials 3+4, again between about brachials 15+16, and distally at intervals of from 3 to 5 muscular articulations.

P_1 7 mm. long with 21 or more short segments of which the basal 4 or 5 are produced dorsally into a broad thin keel; all the segments have their edges armed with tufts of very fine spines. P_2 is 5 mm. long with 16 segments of which the basal 3 or 4 have a thin dorsal keel which, however, is not nearly so wide as that on the preceding pinnule. P_1 and P_2 are somewhat flattened laterally. The three following pinnules are in general similar to P_2 but more slender. The pinnules of the next 3 or 4 pairs have the third–sixth segments laterally expanded as a cover to the gonads, after which the pinnules become slender and more elongated, reaching a length of 8 mm. with 15 segments.

After examining the type specimen of *Antedon gracilis* in the British Museum Prof. Torsen Gislén said that *gracilis* is close to *hirsuta* and *pubescens*, and probably all three will turn out to belong to one species.

Localities.—*Challenger* station 214; off the Meangis Islands, southeast of Mindano, Philippines (lat. 4°33′ N., long. 127°06′ E.); 914 meters; bottom temperature 5.4° C.; blud mud; February 10, 1875 [P. H. Carpenter, 1888; Hartlaub, 1895; A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1918; Gislén, 1928] (4, B. M.).

Albatross station 4919; Eastern Sea, about 90 miles west-southwest of Kagoshima Gulf, Japan; Kusakaki Jima bearing N. 18° E., 17.6 miles distant (lat. 30°34′00″ N., long. 129°19′30″ E.); 804 meters; bottom temperature 5.4° C.; globigerina ooze; August 13, 1906 [A. H. Clark, 1907, 1908, 1909, 1912, 1915, 1918; Gislén, 1928] (2, U.S.N.M., 22631, 35590).

History.—*Antedon gracilis* was described and figured by Dr. P. H. Carpenter in his report upon the comatulids of the *Challenger* expedition published in 1888; his material consisted of five specimens from station 214, off the Meangis Islands in 500 fathoms. In 1895 Dr. Clemens Hartlaub discussed the systematic and bathymetrical relationships of *Antedon gracilis.*

In 1907 I described *Antedon pubescens* from two specimens from *Albatross* station 4919. In my first revision of the old genus *Antedon* published later in 1907 I listed *Thalassometra pubescens* and also *Thalassometra pergracilis,* explaining that the latter was a "new name for *Antedon gracilis* P. H. Carpenter, 1888, preoccupied (cf. *Antedon gracilis* de Loriol, 1886)"; this was repeated in 1908. In 1908 *Thalassometra pubescens* was listed as one of the crinoids occurring off southern Japan, and in two other papers it was said to belong to a group characteristic of the oceanic fauna. In 1909 in my revision of the family Thalassometridae *pergracilis* and *pubescens* were listed as species of the genus *Thalassometra,* and in another paper published in the same year *Thalassometra pergracilis* was compared with a new species, *Th. attenuata.* In a paper published in 1912 it was compared with another new species, *Th. perplexa.* In my memoir on the crinoids of the Indian Ocean published in 1912 *Thalassometra pergracilis* was recorded from about 30 miles west of Middle Andaman in about 485 fathoms, and notes were given on the specimen; *Th. pubescens* was listed, and the synonymy and range were given. In a paper on the crinoids of the British Museum published in 1913 I gave notes on four of Carpenter's specimens of *Antedon gracilis* that I had examined. In 1915 I again listed *Thalassometra pubescens* as a southern Japanese species, and discussed the significance of its range. In my memoir on the unstalked crinoids of the *Siboga* expdeition published in 1918 *pubescens* and *pergracilis* were included in the key to the species of the genus *Thalassometra; pergracilis* was given among the species with the cirri arranged, more or less regularly, in 15 crowded columns, while *pubescens* was given among those in which the cirri are arranged in 10 definite columns. *Thalassometra pubescens* and *Th. pergracilis* were listed, and the synonymy and range of each were given. I said that "I am now convinced that the specimen from the Andaman Islands in about 485 fathoms of water which I recorded as *Thalassometra pergracilis* does not in reality represent that species. It is in too poor condition for definite determination."

After examining Carpenter's specimens in the British Museum in August 1925, Prof. Torsten Gislén in 1928 noted that the cirri are arranged in 10 columns on the centrodorsal, not in 15 as stated by me in the *Siboga* report. My statement that the cirri are arranged in 15 columns was based upon Carpenter's figure 4 on plate 12, which clearly shows 3 columns in one radial area, and the same impression is given by figure 1 on plate 15. In drawing these animals errors of this sort are easily made unless part of the centrodorsal is denuded of cirri. Gislén pointed out that the name *pergracilis* suggested by me for this species in 1907 is quite superfluous. He noted that the *Antedon* (*Solanocrinus*) *gracilis* mentioned by de Loriol in 1888 had originally been described as *Solanocrinus gracilis* by Walther in 1886, so that *Antedon gracilis* of Carpenter is not preoccupied. Gislén places Walther's *Solanocrinus gracilis* in the genus *Pachyantedon.*

THALASSOMETRA ECHINATA (P. H. Carpenter)

Antedon echinata P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 119 (description; *Challenger* station 170A), pl. 21, figs. 4, 5.—HARTLAUB, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (systematic and bathymetrical relationships).—BATHER, Geol. Mag., dec. 4, vol. 3, 1897, p. 120 (pinnules compared with those of *Millericrinus recubariensis*).—HUTTON, Index faunae Novae Zealandiae, 1904, p. 290 (listed).—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 33 (of P. H. Carpenter, 1888=*Thalassometra echinata*).

Thalassometra echinata A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (belongs to a group characteristic of the oceanic area); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14 (listed); Crinoids of the Indian Ocean, 1912, p. 208 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 46 (published reference to specimens in B. M.; *Challenger* station 170); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 166 (in key; range), p. 171 (references).—GISLÉN, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 7, No. 26 (notes).

Diagnostic features.—The cirri have only 25 segments; the elements of the division series and first two brachials have sharp straight edges fringed with spines, and very narrowly flattened sides; and the cirri are arranged in 10 definite columns on the centrodorsal. The 10 arms are 30 or 35 mm. long.

Description.—The centrodorsal is low hemispherical. From the figure the cirrus sockets appear to be arranged in 10 columns of usually two each, but the surface of the centrodorsal is not differentiated.

The cirri are about XX, 25. The fifth segment is the longest, twice as long as broad; the segments in the outer half of the cirri are about as long as broad. The fifth segment has a slight projection on its distal dorsal edge that becomes a spiny keel on the short outer segments.

The radials are just visible. The IBr$_1$ are nearly oblong, not very convex, and are barely united laterally. The IBr$_2$ (axillaries) are about twice as long as the IBr$_1$, broadly pentagonal, with slight backward projections. The elements of the IBr series and first two brachials have sharp straight edges fringed with spines and very slightly flattened sides. Professor Gislén noted that the spines on the ossicles are confined almost exclusively to their borders; there are two spines on the central dorsal surface.

The 10 arms are probably 30 or 35 mm. long. The first two brachials are nearly oblong. Those following are obliquely quadrate and are as long as, or longer than, broad.

Syzygies occur between brachials 3+4, between about brachials 14+15, and distally at intervals of from 3 to 5 muscular articulations.

P$_1$ is not much longer than P$_a$ and consists of about 12 segments of which the first 5 are rather expanded, with the inner edges a little cut away; all have tufts of small spines along the dorsal border. The next two pairs of pinnules (P$_2$ and P$_b$ and P$_3$ and P$_c$) decrease slowly in length and become less spinous. The later ones are long, slender, and tolerably smooth.

The disk is 3 mm. in diameter, much incised and well plated. The pinnule ambulacra have fairly definite side plates, and large sacculi are occasionally present.

The color in alcohol is light brownish white.

Locality.—Challenger station 170A, near the Kermadec Islands, north of New Zealand (lat. 29°45′ S., long. 178°11′ W.); 1,152 meters; bottom temperature 4.17° C.; volcanic mud; July 14, 1874 [P. H. Carpenter, 1888; Hartlaub, 1895; Bather, 1897; Hutton, 1904; A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1918; Gislén, 1928] (1, B. M.).

History.—Antedon echinata was described and figured by Dr. P. H. Carpenter in 1888 in his report on the comatulids of the *Challenger* expedition, his material consisting of a single specimen from station 170A. Dr. Clemens Hartlaub in 1895 discussed the systematic and bathymetrical relationships of *Antedon eehinata;* Dr. F. A. Bather in 1897 compared it with the fossil *Millericrinus reeubariensis;* and Capt. F. W. Hutton in 1904 included it in his list of New Zealand echinoderms.

In my revision of the genus *Antedon* published in 1907 *echinata* was transferred to the new genus *Thalassometra;* in 1908 I twice mentioned *Thalassometra eehinata* as a member of a group characteristic of the oceanic area; and in 1909 in my revision of the family Thalassometridae I listed it in the genus *Thalassometra.* In my memoir on the crinoids of the Indian Ocean published in 1912 I listed *Thalassometra eehinata* and gave the range, and in 1913 I noted that I had examined the type specimen in the British Museum. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *eehinata* was included in the key to the species of *Thalassometra,* and the synonymy and range were given. After examining the type specimen at the British Museum in 1925, Prof. Torsten Gislén in 1928 published a short note amplifying the original description.

THALASSOMETRA PERIPOLOS A. H. Clark

Plate 18, Figures 56, 57

Thalassometra peripolos A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, 1929, p. 635 (listed), p. 651 (south of the Nicobar Islands, 560 fathoms; description; remarks), p. 653 (southeast of Car Nicobar), pl. 40, figs. 3, 4.

Diagnostic features.—There are no long curved spines near the distal edge of the brachials; the cirri are XVII, 31–38, from one-quarter to nearly one-third the arm length; the arms (in the two known specimens) are 11 in number, the IIBr series being 4(3+4); the dorsal surface of the division series is thickly beset with excessively fine spines which are often grouped in irregular bundles; on the lower brachials these become more scattered in the central portion of the dorsal surface; on the triangular and succeeding brachials the entire dorsal surface is beset with very fine spines, which become longer on the slightly produced distal border.

Description.—The centrodorsal is low, flattened hemispherical, with the almost flat dorsal pole finely pitted and finely spinous. The cirrus sockets are arranged in one and a partial second crowded marginal rows, there being usually three at the margin beneath each radial.

The cirri are XVII, 31–38 (usually about 35), from 20 to 25 mm. long. The first segment is very short, the second is slightly longer, the third is about two and one-half times as broad as long, the fourth is half again as broad as long, and the fifth is somewhat longer than broad. The sixth, or more rarely the seventh, is a transition segment, somewhat less than twice as long as broad, with the distal third white, in sharp contrast to the dark brownish yellow proximal two-thirds. The following segments are similar, but less constricted centrally. The segments succeeding slowly decrease in length so that those in the terminal fourth of the cirri are half again as broad as long. On the transition segment the distal edge dorsally is everted and slightly produced, and finely dentate. As the segments become shorter this eversion of the distal edge dorsally increases, becoming narrower and extending proximally so as to involve a triangular area on the dorsal surface. In lateral view these processes appear as prominent blunt dorsal spines arising from almost the whole of the dorsal surface of the segments with the apex subterminal. On a few of the segments immediately preceding the penultimate the process narrows into a small dorsal tubercle. The opposing spine is triangular, arising from the entire dorsal surface of the penultimate segment, with the apex submedian to subterminal; its height is equal to about one-third the lateral width of the segment. The terminal claw is about as long as the two preceding segments together, and is evenly tapering and slightly and evenly curved.

The radials are entirely concealed by the centrodorsal in the median line, but their anterolateral angles are visible interradially as small rounded tubercles which usually are armed with exceedingly short fine spines. The IBr_1 are very short, crescentic or bandlike, becoming narrow laterally, and are in close lateral contact. Their surface is thickly covered with excessively fine spines which are often grouped on irregular pedicels suggesting paxillae. The IBr_2 (axillaries) are about three times as broad as long, triangular or subrhombic, with the lateral angles truncated and in close lateral contact with those of their neighbors. The anterior edges are slightly thickened. The entire surface is thickly beset with excessively fine spines which are more or less grouped on low irregular bases. The division series are broad, in close lateral contact, and sharply flattened laterally. They are only very moderately convex dorsally. The IBr series are 4(3+4).

The 11 arms are 80 mm. long. The first brachials are very short, four or five times as broad as the median length, half again as long exteriorly as interiorly, in close apposition and flattened against their fellows. The proximal and distal edges are slightly thickened and densely beset with excessively fine spines, which are also found more or less on the remainder of the dorsal surface. The second brachials are twice as large as the first, wedge-shaped, twice as long exteriorly as interiorly; the edges are slightly thickened and densely spinous, and the dorsal surface is more or less spinous. On the outer lateral edges of both the first and second brachials the spines become longer and are grouped on more or less prominent irregular bases. The first syzygial pair (composed of brachials 3+4) is more than twice as broad as long, oblong or slightly longer interiorly than exteriorly. The proximal and distal borders are everted and densely spinous and there is a double row of spines along the syzygial line, but otherwise the dorsal surface is devoid of spines. The next four brachials are slightly wedge-shaped, about three times as broad as long, with the edges, both proximal and distal, rather thickly everted and densely spinous, and numerous spines on the dorsal surface. The following brachials are triangular, about as long as broad, with the entire dorsal surface beset with very fine spines which become longer on the slightly produced, but not overlapping, distal edge. Distally the brachials become wedge-shaped, as long as broad, and terminally longer than broad and ultimately elongate, while at the same time the spines on the dorsal surface become longer, more prominent, and more uniform in size, and are inclined so that they are directed diagonally outward from the arm.

P_1 is 8 mm. long with 20–21 segments and tapers evenly from the base to the slender tip. The segments are at first broader than long, becoming about as long as broad on the eighth and terminally longer than broad. The earlier segments have a broad band of fine spines on the distal edge, and after about the eighth the whole outer side becomes spinous in addition.

P_2 is somewhat shorter and more slender than P_1 and is composed of about 16 segments. P_3 is very slightly shorter than P_2, with 16 segments. The genital pinnules have the fourth–seventh segments slightly broadened.

Notes.—The specimen described is from south of the Nicobar Islands in 1,024 meters. A smaller specimen from southeast of Car Nicobar is quite similar to the one described, though slightly smaller. It also has 11 arms, one IIBr 4(3+4) series being present. All of the arms are broken off at the first brachial syzygy. The cirri are XXII, 32–34, from 20 to 23 mm. in length. The apical cirri are smaller and shorter than the peripheral, 15 mm. long with 26 segments. The basal cirrus segments have finely spinous ends and a few short spines on the dorsal surface.

Localities.—South of the Nicobar Islands; 1,024 meters; cable repair ship *Patrol,* Eastern and Associated Telegraph Company [A. H. Clark, 1929] (1, B. M.).

Southeast of Car Nicobar (lat. 7°15′24″ N., long. 92°59′00″ E.); cable repair ship *Patrol*, Eastern and Associated Telegraph Company [A. H. Clark, 1929] (1, B. M.).

Remarks.—This species is evidently most closely related to *Th. multispina* of the south Atlantic from which it differs in the larger size, greater number of cirrus segments, and less uniform distribution of spines on the dorsal surface of the elements of the division series.

THALASSOMETRA MULTISPINA (P. H. Carpenter)

Antedon multispina P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 117 (description; station 344), p. 248 (description; station 344 [but not station 135G = *Th. setosa*]), pl. 13, figs. 1–3, pl. 69, figs. 1–4 [not pl. 14, figs. 5–7 = *Koehlermetra porrecta*, or pl. 50, figs. 3–6 = *Th. setosa*]; Journ. Linn. Soc. (Zool.), vol. 24, 1891, p. 66 (comparison with [*Stiremetra*] *lusitanica*).—HARTLAUB, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (in *Basicurva* group; bathymetric relationships), pp. 134, 136 (comparison with *Th. agassizii*).—LANG, Text book of comparative anatomy, 1896, vol. 2, p. 375, fig. 326D.—MINCKERT, Arch. Naturg., Jahrg. 71, 1905, vol. 1, Heft 1, pp. 170 and following (syzygies; regeneration).—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, pp. 1578, 1582 (listed).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 285 (in the *Granulifera* group; doubtless different from *granulifera*), p. 286 (referred by Clark to the Thalassometrinae).

Thalassometra multispina A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed); Amer. Nat., vol. 42, No. 500, 1908, p. 542 (belongs to a group characteristic of the oceanic area); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (same); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 14 (listed); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 8 (west coast of Africa), p. 38 (synonymy; near Ascension, 420 fathoms, volcanic sand); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 47 (published references to specimens in the B. M.; *Challenger* Sta. 344 [but not 135 = *Th. setosa*]; notes); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 166 (in key; range), p. 171 (references); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range).—GISLÉN, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 6, No. 24 (notes on specimens in the British Museum) —A. H. CLARK, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 654 (compared with *Th. peripolos*, sp. nov.).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 22.

Diagnostic features.—The cirri are arranged in 15 crowded columns on the centrodorsal; the elements of the division series and lower brachials have numerous fine spines on the dorsal surface. The 10–12 arms are 50 mm. long, and the cirri have 25–30 segments.

Description.—The centrodorsal is low-hemispherical. From the figures the cirrus sockets appear to be arranged in 15 columns, but the surface of the centrodorsal is not differentiated into radial areas.

The cirri are about XX, 25–30; a few of the segments are longer than broad, and the remainder are shorter and overlap slightly so as to develop a dorsal spine.

The radials are not visible in the adult. The IBr_1 in the adult are very short, and the IBr_2 (axillaries) are widely pentagonal. The axillaries and first brachials have flattened outer sides and straight lateral edges, and the inner side of the second brachial and of the hypozygals of the first syzygial pair are also flattened. There are numbers of small spines on the elements of the IBr series and arm bases. The IIBr series, when present, are 4(3+4) and resemble the IBr series.

The 10–12 arms are probably about 50 mm. long. Of the four specimens described by Carpenter three had 10 arms and one had 12, with two IIBr 4(3+4) series present. The brachials are elongately quadrate with tufts of numerous small spines at one or both ends.

Syzygies occur between brachials 3+4, again from between brachials 10+11 to between brachials 15+16, and distally at intervals of 4 or 5 muscular articulations. In arms arising from a IIBr 4(3+4) series the first syzygy is between brachials 1+2.

P_1 is composed of about 25 segments the lowest of which are broad with their inner edges a little cut away and the outer sides slightly flattened. The pinnules of the next pair are much smaller, and those following gradually increase in length; in these the lower segments are at first broadly V-shaped, later more elongated. From about the twelfth brachial onward the pinnules have the third and next following segments expanded for the protection of the gonads, having a broadly V-shaped cross section, though this is less marked than in *Th. gracilis*. In the specimen with two IIBr 4(3+4) series P_1 consists of rather massive segments with their inner edges cut away a little and the outer sides flattened. It is much larger than its successors.

The disk is 4 mm. in diameter and is well plated. Side plates are fairly well developed on the pinnule ambulacra, and sacculi are moderately abundant.

The color in alcohol is light brownish white.

Notes.—In the youngest of the three immature individuals not only the basals, but also portions of the radials are concealed, and the pinnules of the first two pairs have appeared, though from the sixth to the thirteenth brachials the arms are devoid of pinnules. In an older individual the radials are only just visible externally, though the IBr_1 are relatively much longer than in the mature form. All the brachials are provided with pinnules, although the lowest ones are quite small, P_1 being much more like its successors than in the adult, while there is but little trace of any expansion in the lower segments of the genital pinnules.

The spines on the cirri are present from the first, but those on the division series, arms, and pinnules do not appear until after the pentacrinoid stage, while the lateral flattening of the radials and lower brachials is one of the last characters to make its appearance.

Locality.—*Challenger* station 344; south Atlantic near Ascension (lat. 7°54′20″ S., long. 14°28′20″ W.); 768 meters; volcanic sand; April 3, 1876 [P. H. Carpenter, 1888, 1891; Hartlaub, 1895, 1912; Lang, 1896; Minckert, 1905; A. H. Clark, 1907, 1908, 1909, 1911, 1913, 1918, 1923, 1929; Gislén, 1928, 1934] (2, B. M.).

History.—This species was described and figured under the name of *Antedon multispina* by Dr. P. H. Carpenter in his report upon the comatulids of the *Challenger* expedition published in 1888. The description was based upon four broken individuals from station 344. The three pentacrinoid larvae also secured at this station and considered by Carpenter as belonging to this species possibly represent *Crotalometra porrecta* (see Part 2, p. 521, pl. 34, figs. 1207–1209). *Antedon multispina* was first described in the *Basicurva* group, and the only locality given was station 344. A supplementary description, with additional figures, was given under the *Granulifera* group, which was based upon a single mutilated specimen from station 135G. This specimen is herein regarded as representing a different species, *Th. setosa* (see page 182).

In a discussion of *Antedon* (*Stiremetra*) *lusitanica* published in 1891 Carpenter compared the occurrence of a syzygy between brachials 1+2 on arms arising from a IIBr 4(3+4) series with the condition in *Antedon* (*Thalassometra*) *multispina* and in *Antedon* (*Crotalometra*) *porrecta*. He said that *multispina* "like *Antedon lusitanica*, may sometimes have no more than ten arms, as in the six 'Challenger' specimens from Ascension; while the single individual from Tristan D'Acunha [=*Th. setosa*] possesses one bidistichate [IIBr 2] and two tridistichate [IIBr 4(3+4)] series, two of the arms borne on the latter having a syzygial union between the first two brachials, while the other two are of the ordinary type, with a syzygy in the third brachial [i. e., between brachials 3+4]." He said that "should the tridistichate condition eventually prove to be common in these two species, it may become necessary to unite them under one name. At present the main points of difference between them, apart from the characters of the arm-divisions, appear to lie in the longer cirri and less spinous arms of *A. lusitanica*, in which also the joints of the genital pinnules, as the Madeira specimens show, are somewhat produced upward on the outer side, as is so markedly the case in *Antedon* [*Charitometra*] *basicurva*, but there is nothing of this kind in *A. multispina*."

In 1895 Dr. Clemens Hartlaub discussed the systematic and bathymetrical relationships of *Antedon multispina* and compared it with his new species *A.* (*Thalassometra*) *agassizii*. In 1905 Wilhelm Minckert discussed the distribution of the syzygies in *A. multispina*.

In my revision of the genus *Antedon* published in 1907 *multispina* was assigned to the new genus *Thalassometra*, and in two papers published in 1908 *Thalassometra multispina* was said to belong to a group characteristic of the oceanic area. In my revision of the family Thalassometridae published in 1909 *Thalassometra multispina* was listed. In a paper on the crinoids of the coasts of Africa published in 1911 I included *Th. multispina*, giving the synonymy and the record from near Ascension.

Dr. Clemens Hartlaub, in discussing Carpenter's *Granulifera* group in 1912, said that, without expressing a definitive judgment, in his opinion *Antedon angusticalyx*, *A. inaequalis*, and *A. distincta* were synonyms of *A. granulifera*, but that *A. porrecta* and *A. multispina* were doubtless distinct.

In a paper on the crinoids of the British Museum published in 1913 I noted that I had examined two specimens and one pentacrinoid young from *Challenger* station 344, and that the spines covering the animal are exceptionally fine. In my report upon the unstalked crinoids of the *Siboga* expedition published in 1918 *multispina* was included in the key to the species of *Thalassometra* and the range was given as near Ascension Island in 756 meters. The references given under *Thalassometra multispina* included both *multispina* and *setosa*. In my report on the crinoids of the *Ingolf* expedition published in 1923 I listed *Thalassometra multispina*, saying "Only known from near Ascension; 768 metres." The specimen from off Tristan da Cunha in 1,005 meters I listed as *Thalassometra setosa*. Both *multispina* and *setosa* were included in my key to the species of *Thalassometra*.

Prof. Torsten Gislén in 1928 gave notes on a young specimen of *Thalassometra multispina* and said that older specimens had fewer cirri. He gave the locality as *Challenger* station 135G, which is the locality for *Th. setosa;* but all but one of the specimens must have come from station 344, the locality for *Th. multispina*.

In 1929 I compared a new species, *Thalassometra peripolos* from the Nicobar Islands, with *Th. multispina*. Professor Gislén in 1935 discussed the arm structure of *Thalassometra multispina*.

THALASSOMETRA SETOSA (A. H. Clark)

Antedon, sp. WYVILLE THOMSON, The Atlantic, vol. 2, 1877, p. 193 (near Tristan; 550 fathoms).

Antedon setosa P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 34 (off Tristan da Cunha; *nomen nudum*).

Antedon multispina (part) P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 248 (station 135G; notes), pl. 50, figs. 3–6, and following authors.

Thalassometra multispina (part) A. H. Clark, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 47 (*Challenger* station 135 [but not station 344 = *Th. multispina*]).—Gislén, Ark. Zool., vol. 19A, No. 32, 1928, p. 24 (young specimen mentioned, but not pentacrinoids Nos. 1–3).

Thalassometra setosa A. H. Clark, The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range), p. 57 (in key).

Diagnostic features.—The cirri are arranged in 15 crowded columns on the centrodorsal; the elements of the division series and lower brachials have a few scattered fine spines on the dorsal surface. There are 13 arms probably about 50 mm. long, and the cirri have 35 segments.

Characters.—The centrodorsal is flattened-hemispherical with the cirri apparently irregularly arranged, possibly in 15 columns, or 3 columns in each radial area.

The cirri are about XXXII, in general similar to those of *Th. multispina*, but they may have as many as 35 segments.

The radials are visible. The IBr series, brachials, and pinnule segments are less distinctly spinous than those of *Th. multispina*.

There are 13 arms, two IIBr 4(3+4) series and one IIBr 2 series being present. On the arms arising from the IIBr 2 series the first syzygy is between brachials 3+4; but in the arms following the two IIBr 4(3+4) series one has the first syzygy between brachials 1+2, while in the other it is between brachials 3+4.

P_1 has somewhat the same flattened appearance on the outer side as is traceable in *Th. multispina*, but it is so slight as to be hardly recognizable except by a trained eye, and the same may be said of the lateral flattening of the lower brachials.

The plating of the disk is very incomplete, and the ambulacral skeleton of the pinnules is by no means well differentiated.

The characters given above are taken from Carpenter's notes on the only known specimen, supplemented by his figure and Gislén's statement of the number of the cirri.

Locality.—*Challenger* station 135G; south Atlantic, off Tristan da Cunha (lat. 37°10′50″ S., long. 12°18′30″ W.); 1,005 meters; hard ground; October 18, 1873 [Wyville Thomson, 1877; P. H. Carpenter, 1888; A. H. Clark, 1913, 1923; Gislén, 1928] (1, B. M.).

History.—This species was first mentioned in 1877 by Prof. Sir Wyville Thomson who noted that the *Challenger* dredged *Antedon*, sp., off Tristan da Cunha in 550 fathoms.

In the introductory chapter on geographical and bathymetrical distribution in the *Challenger* report on the comatulids published in 1888 Dr. P. H. Carpenter mentioned "*Antedon setosa* from off Tristan da Cunha" (p. 34), but in the descriptive portion of the work he included the single mutilated specimen from station 135G under *Antedon multispina* in his supplementary account of that species (p. 248) as a member of the *Granulifera* group. He gave a number of features by which the specimen from Tristan da Cunha is distinguished from the four dredged near Ascension (= *Th. multispina*), and figured it.

In my earlier papers this form was included in *Thalassometra multispina*, and I did not distinguish the two in my notes on the crinoids of the British Museum published in 1913. In my report on the crinoids of the *Ingolf* expedition published in 1923 *setosa* was included in the key to the species of *Thalassometra* occurring in the Atlantic, and the locality and depth were given. In 1928 Prof. Torsten Gislén noted that the specimen of *Thalassometra multispina* from *Challenger* station 135G had the cirri about XXXII.

THALASSOMETRA OMISSA (Koehler)

Antedon omissa Koehler, Résultats des campagnes scientifiques accomplies sur son yacht par Albert 1er Prince souverain de Monaco, fasc. 34, 1909, p. 268 (description; *Princesse-Alice* station 1713, 1904), pl. 32, fig. 10.—Mortensen, Handbook of the echinoderms of the British Isles, 1927, p. 25.

Thalassometra omissa A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 7 (occurs on the northwestern coast of Africa), p. 37 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 166 (in key; range), p. 171 (synonymy); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range), p. 57 (in key).—Mortensen, Handbook of the echinoderms of the British Isles, 1927, p. 25.

Diagnostic features.—The cirri are arranged in 15 crowded columns; the elements of the division series and lower brachials are smooth dorsally except for a few minute spines along the proximal and distal edges· and the brachials have the distal border thickened, forming a transverse crest that bears a few very fine spines. There are 10 arms, and the cirri are about 17 mm. long with 21 segments.

Description.—The centrodorsal is hemispherical, with the cirrus sockets apparently arranged in 15 columns.

The cirri are XX+, 21, about 17 mm. long. The two first segments are very short, the third is slightly longer, the fourth and fifth are much longer, and the sixth, which is the longest, is about twice as long as broad. Beyond this point the length gradually decreases to the twelfth which, with the segments following, is about as long as broad. From the sixth segment onward a small spine appears toward the distal end which, gradually moving toward the middle of the segments, continues to the end of the cirrus. There are X principal cirri and a few other smaller ones that rise vertically between the arms.

The radials are partially visible. The IBr_1 are almost twice as broad as long with the distal border slightly incised by the IBr_2 (axillaries), of which the dorsal surface is slightly convex, the distal angle is rather sharp, and the dorsal surface is depressed toward the central portion in such a way that the articular border is somewhat projecting. The elements of the IBr series and the first brachials are slightly flattened laterally. The diameter of the proximal portion of the animal is 4 mm.

The 10 arms are all broken, the longest arm stump being only 30 mm. long. The first two brachials are short, broader than long, and those following gradually elongate, at the same time becoming narrower. The dorsal surface of the first two brachials is depressed in such a way as to render the proximal and distal edges, especially the latter, slightly projecting. The brachials following show the same central depression, the distal edge projecting as far as the twelfth or fifteenth. Under a lens it is seen that this raised edge is provided with very short spines difficult to make out that appear from the seventh or eighth brachial onward.

Syzygies occur between brachials 3+4, again between brachials 11+12, or sometimes 12+13, and distally at intervals of from 4 to 6 muscular articulations.

P_1 and P_a are large and well developed with about 12 segments of which the first three or four are broader than long, those succeeding becoming elongated and very slender. They are slightly carinate. Under the microscope these pinnules show very fine spines, short and sparse, much less abundant than the spines in *Th. echinata*. P_2 is very short, with only 6 segments. The pinnules following increase slightly in length. On about the eighth there are 8 segments, and a little farther on, 9. The segments increase in length as their number increases. On a detached arm fragment there are pinnules 5 mm. long with 10 segments. The arrangement of the pinnules resembles that in *Th. latipinna*.

Notes.—Professor Koehler said that this species is most closely related to *Th. echinata* from which it is distinguished by the less numerous cirri with less numerous segments. The brachials are shorter with the distal border thickened forming a transverse crest which bears only a few very fine spines. Although strongly developed, P_1 bears only a few very fine and scattered spinules which are invisible to the naked eye.

Locality.—*Princesse-Alice* station 1713; off the southeastern coast of Tenerife, Canary Islands (lat. 28°04′ N., long. 16°49′30″ W.); 1,330–1,340 meters; August 1, 1904 [Koehler, 1909; A. H. Clark, 1911, 1918, 1923; Mortensen, 1927] (1, Monaco Mus.).

History.—Prof. René Koehler described and figured *Antedon omissa* in 1909 from a single specimen in rather poor condition that had been dredged by Prince Albert I of Monaco's yacht *Princesse-Alice* in 1904 at station 1713.

In a paper on the crinoids of the African coasts published in 1911 I included *Thalassometra omissa* and gave the range. In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *omissa* was included in the key to the species of *Thalassometra* and the synonymy and range were given. In my memoir on the crinoids of the *Ingolf* expedition published in 1923 *omissa* was included in the key to the Atlantic species of *Thalassometra*, and the range was given. Dr. Th. Mortensen in his handbook of the echinoderms of the British Isles published in 1927 included a notice of *Thalassometra omissa*.

THALASSOMETRA sp.

Thalassometra pergracilis (part) A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 207; Unstalked crinoids of the *Siboga* Expedition, 1918, p. 170.

Locality.—*Investigator;* about 30 miles west of Middle Andaman; about 887 meters (485 fathoms) [A. H. Clark, 1912, 1918] (1, I. M.).

Remarks.—Regarding this individual I wrote in 1912:

> One mutilated specimen, agreeing well with Carpenter's description and figures. The centrodorsal is rounded conical, 4 mm. broad at the base and 3 mm. high; the cirrus sockets are arranged in ten columns, two to each radial area, those of each radial area being separated interiorly by a rather strong ridge, exteriorly in close apposition with the columns of adjacent radial areas; the dorsal pole is rough, covered with irregular tubercles; the disk is almost entirely covered with small rounded concretions; the disk ambulacra are bordered with similar, but somewhat smaller and more thickly set, plates which become radially elongated about the mouth; the perisome of the arms is covered with small round concretions, and the interbrachial perisome with large flat plates.

In 1918 I wrote that I was convinced that this specimen does not in reality represent *Th. pergracilis* (=*gracilis*), and that it is in too poor condition for definite determination.

Genus HORAEOMETRA A. H. Clark

Antedon (part) VON GRAFF, Bull. Mus. Comp. Zool., vol. 11, No. 7, 1883, p. 133, and following authors.

Thalassometra (part) A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360.

Cosmiometra (part) A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 154.

Horaeometra A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 160 (only included species *H. duplex* [P. H. Carpenter]); Univ. Iowa Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (confined to the West Indies), p. 19 (in key); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., No. 11, 1934, p. 18.

Diagnosis.—A genus of Thalassometridae in which the third–fifth segments of the genital pinnules are greatly expanded, forming a roof over the gonads; there are 10–22 arms with all the division series 2; and the cirri are arranged in 10 columns on the centrodorsal. The single included species is small and delicate, with the arms up to 50 mm. in length.

Geographical range.—From northern Cuba eastward and southward along the Antillean chain to St. Vincent and ?Grenada.

Bathymetrical range.—From 159 to 479 meters.

Thermal range.—From 8.3° to 16.67° C.

History.—The only known species of this genus was first mentioned as *Antedon duplex* by Prof. Ludwig von Graff in 1883, this name having been furnished him by Dr. P. H. Carpenter, who later used it in his report upon the comatulids of the *Challenger* expedition published in 1888. In my first revision of the old genus *Antedon* published in 1907 *duplex* was referred to the new genus *Thalassometra.* In my revision of the family Thalassometridae published in 1909 I included *Antedon duplex* in a list of species which I was unable to place satisfactorily. In my report upon the unstalked crinoids of the *Siboga* expedition published in 1918 I included the new generic name *Horaeometra* in a key to the genera of the subfamily Thalassometrinae, and under this name I listed *Horaeometra duplex,* with its synonymy. At the same time I included the new specific name *koehleri* in the key to the species of the genus *Cosmiometra,* giving as the range St. Vincent, in 158 meters; *C. koehleri* subsequently proved to be based upon a specimen of *H. duplex.* Since 1918 the status of the genus *Horaeometra* has remained unchanged.

HORAEOMETRA DUPLEX (P. H. Carpenter)

Plate 6, Figure 24

[See also vol. 1, pt. 2, fig. 321, p. 227.]

Antedon duplex von Graff, Bull. Mus. Comp. Zool., vol. 11, No. 7, 1883, p. 133 (*nomen nudum;* off St. Vincent, 124 fms.; myzostomes).—von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 17, 18, 75 (*nomen nudum; Blake* station 269; myzostomes).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 54 (specific formula), p. 207 (10-armed *Blake* species), p. 208 (both 10-armed and multibrachiate), p. 211 (myzostomes), p. 212 (in key to the species of the *Spinifera* group), p. 217 (compared with [*Stiremetra*] *lusitanica*), pp. 367, 368 (bathymetrical range), pp. 375, 378 (Caribbean islands and Straits of Florida, 88–262 fms.).—Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 130 (systematic and bathymetrical relationships), p. 135 (compared with *A.* [*Thalassometra*] *agassizii*).—Minckert, Archiv Naturg., Jahrg. 71, 1905, vol. 1, Heft 1, p. 211 (syzygies; arm division).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, pp. 1578, 1581 (listed).—A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 18 (not placed in a revision of the Thalassometridae).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 280 (in the *Blake* collection), p. 309 (in the *Spinifera* group; history), pp. 366–370 (*Blake* stations 232, ?249; detailed description and discussion), pl. 3, figs. 2, 4–11, pl. 14, figs. 5, 10, 13.

Thalassometra duplex A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (listed).

Cosmiometra koehleri A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 154 (in key; range; based on *Antedon duplex* Hartlaub [part], Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 366, pl. 3, figs. 2, 4; pl. 14, figs. 5, 10).

Horaeometra duplex A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 160 (references); The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range).—H. L. Clark, Mem. Soc. Cubana Hist. Nat., vol. 15, No. 1, May 1941, p. 9 (*Atlantis* stations 2999, 3303, 3437, 3465, 3466, 3467, 3478, 3479, 3480; off the north coast of Cuba, about 100 fathoms).

Diagnostic features.—The broad and conspicuous expansion of the third-fifth segments of the genital pinnules at once distinguishes this species from all others in the family Thalassometridae. It is a small and delicate form with the 10–22 (usually 15–20) arms reaching 45–50 mm. in length, and the cirri 15–20 mm. long with 32–50 (usually 32–35) segments.

The great variation in the number of the arms is very deceptive, and it is often difficult to believe that the slender 10-armed individuals can belong to the same species as the much stouter examples with 20 arms.

Description.—The centrodorsal is broad, truncated conical, with the cirrus sockets arranged in ten columns of three or four each, the two columns of each radial area being rather widely separated from each other but closely crowded against the columns of the areas adjacent. In each midradial region there is a deep V-shaped space between the columns of cirrus sockets which accommodates the posterior process from the IBr axillary, the rounded posterior end of this lying sometimes as much as halfway between the proximal rim and the dorsal pole. When the posterior process does not descend so deeply the pairs of columns of cirrus sockets are separated by a very deep and broad V-shaped furrow with a V-shaped cross-section. The dorsal pole is broad, flat, rough, or papillose.

The cirri are XII, 32–35, from 15 mm. to 17 mm. long; the longest proximal segments (the 5th–7th) are twice as long as broad; from the seventh or eighth onward the segments bear very prominent long and slender dorsal spines; the fifth is a well-marked transition segment.

The ends of the basal rays are visible as small rounded tubercles in the interradial angles. The radials are concealed. The IBr_1 form a very narrow border between the posterior process of the IBr_2 (axillary) and the centrodorsal. The IBr_2 are broader than long with all four sides deeply concave so that the lateral quarters are exceedingly narrow with parallel sides which distally rise to a rather sharp angle—somewhat less than a right angle—and proximally to a relatively deep and narrow rounded posterior process which is longer than the anterior angle, reaching downward to between the first or second cirrus sockets of the interradial columns. The IIBr series are of two elements, and resemble the IBr series. IIIBr series of two ossicles are occasionally present. The division series and arm bases are deep, in close lateral contact, and sharply flattened against their neighbors.

The arms are from 10 to 20 (usually between 15 and 20) in number, about 50 mm. long. There is a broad roughened finely spinular band on the arms which on the triangular brachials becomes lines of serrations.

P_1 is from 3.5 mm. to 5.0 mm. long, rather stout basally but rapidly tapering and becoming slender beyond the sixth segment, composed of 11–14 segments of which the sixth and following are longer than broad. P_2 is 2.5 mm. long, much more slender than P_1 and evenly tapering from the base to the tip, composed of 7 or 8 segments. P_3 is smaller and more slender than P_2, becoming very slender beyond the second segment, about 2. 0 mm. long with 8 segments. On P_4 and the following pinnules the third-fifth segments are very greatly expanded, the expansion being at a maximum on the third or third and fourth and gradually tapering away on the sixth so that the pinnule as a whole has a leaflike outline. The distal pinnules are 3 mm. long with 11 segments.

Notes.—After the death of Dr. P. H. Carpenter the *Blake* collection of comatulids was sent to Dr. Clemens Hartlaub for report. In the collection Hartlaub found three specimens of this species from *Blake* station 232. Two of these were in the same jar with the label "*A. duplex.*" The third which, in spite of many differences, he regarded as representing the same species, he found with some specimens labeled "*A. brevipinna.*" Hartlaub noted that Carpenter apparently had had more specimens than he had received, for in the *Challenger* report he had given the bathymetric range as 88–262 fathoms. The latter depth was that of a station off Grenada, and also of one in the vicinity of St. Vincent, so that perhaps Carpenter had had specimens from station 249, off Grenada, in 262 fathoms. It is possible, he said, that one of the specimens received by him was from station 249 and that the label had been lost.

Hartlaub remarked that in the *Challenger* report Carpenter had placed this species in both the *Spinifera* and *Basicurva* groups.

Hartlaub thus described the two specimens that had been labeled *A. duplex* by Carpenter. The centrodorsal is subconical with strong interradial ridges the ventral ends of which are strongly produced upward in the interradial angles. These interradial ridges, each of which is bordered by a column of 4 or 5 cirrus sockets on either side, are well marked. In the midradial line the columns of cirrus sockets are separated by lower ridges so that as a whole the centrodorsal bears 10 ridges, five strong interradial and five weaker radial. The moderately rounded dorsal pole is smooth and free of cirri.

The cirri are about XL, about 50, up to 20 mm. long, and slender. The segments in the proximal half, with the exception of the basal, are somewhat elongated; those in the distal half are uniformly very short and bear small spines on the distal end. The transition from the longer segments in the proximal half of the cirri to the very short segments in the distal half is very abrupt as in *Stylometra spinifera*.

The radials are not visible in the larger specimen, though they appear in the smaller. The IBr_1 are very flat, and in the larger specimen are partially concealed by the centrodorsal. The IBr_2 (axillaries) are short, almost rhombic, and on the proximal border bear a strong process with a sharply set-off base that passes into the pronounced elevation of the IBr_1, forming a strong synarthrial tubercle. The IIBr series are 2. The $IIBr_2$ (axillaries) are hexagonal, like the IBr axillaries with a proximally directed process which forms a pronounced articular tubercle with the $IIBr_1$. Single IIIBr series are present in the larger specimen.

The smaller specimen has 10 arms about 20 mm. long, and the larger has 20 arms about 45 mm. long, though in life it probably had 22. The surface of the arms is smooth. The first 9 or 10 brachials are more or less discoidal and are all short, the first being the shortest. The form of the second brachials is somewhat variable, according to the point of origin of the arm. On arms arising from a IBr axillary the second brachial has more the form of an axillary. The first syzygial pair (composed of brachials 3+4) is approximately square. From the tenth onward the brachials are approximately triangular. Their proximal and distal ends are arched and have a small sharp lateral point that alternates on succeeding brachials.

Syzygies occur between brachials 3+4, again between brachials 22+23, and distally at intervals of 6 muscular articulations. On arms arising from a IBr axillary, on which the second brachial has the form of an axillary to a marked degree, the first syzygy is between brachials 5+6.

P_1 is markedly longer and stouter than P_2. In the larger specimen it is 5 or 6 mm. long, stout basally, and composed of 10 segments of which the second, and especially the third, are markedly broadened and those following taper rapidly. P_2 is about half as long as P_1 with about 10 segments of which none are especially broadened, the width of the segments tapering gradually from the base of the pinnule to the tip; the majority of the segments are somewhat elongated. P_3 is very similar to P_2 in thickness and in length, but the fourth and fifth segments sometimes show a thin leaflike expansion over the gonads, which are here only slightly developed. P_4 is somewhat longer and shows in pronounced measure the thin leaflike expansion of the third, fourth, and fifth segments, the fourth being the most broadened. The following pinnules as far as P_8 are similar, and all these show gonads on the ventral side. Whether the pinnules with strongly developed expansion of the earlier segments extended farther out along the arms could not be definitely ascertained. The pinnules of about the middle third of the arm are all very small.

The disk is not visible. The ambulacral plating of the pinnules consists of high slide plates and covering plates. Sacculi are not recognizable.

The color in alcohol is brownish white.

Hartlaub remarked that this description differs in some points from the notes published by Carpenter. Carpenter said that the cirri are "without definite arrangement" whereas they are arranged in 10 definite columns; he also said "Radial axillaries long," whereas apart from the proximally directed process in the middle of the proximal border they are very short.

The third rather small specimen that was found with others identified as *A. brevipinna* agrees with the other two. The centrodorsal has five interradial and five radial ridges. No cirri are present. As in the smaller of the two other specimens the radials are visible and are very flat. The radials and the IBr series in this specimen agree almost exactly with those of the smaller of the other two. The IIBr series are 2. The form of the IIBr series and of the first two brachials, and especially of the first syzygial pair, are approximately as in the larger of the two others. There are no IIIBr series. There are 15 arms about 20 mm. long. The first syzygy is between brachials 3+4 and the second is between brachials 17+18.

P_1 is about 2 mm. long and is composed of 9–12 segments of which those in the proximal portion are stout and those in the outer half more slender. The first three segments are broader than long, those succeeding elongated, the terminal shorter again. In general P_1 resembles the same pinnule in the two other specimens. P_2 is about half as long as P_1 with 5 or 6 segments of which the first–third are markedly stouter than those following. The pinnules succeeding are of the same form and length but are composed of fewer segments, as is the case with the corresponding pinnules in the other specimens; there is the same leaflike expansion of the lower segments.

The disk is not visible; the color in alcohol is brownish white.

Hartlaub pointed out that *Horaeometra duplex* is especially noteworthy on account of its relatively small size, his largest specimen, with the arms only 45 mm. long, having well-formed gonads. He pointed out that no less than four of the species assigned by Carpenter to the *Spinifera* group belong also to the *Basicurva* group.

Localities.—*Albatross* station 2342; off northern Cuba (lat. 23°10′39″ N., long. 82°20′21″ W.); 367 meters; coral; January 19, 1885 (2, U.S.N.M., 34560, 34592).

Albatross station 2346; off northern Cuba (lat. 23°10′39″ N., long. 82°20′21″ W.); 366 meters; coral; January 20, 1885 (1, U.S.N.M., 22673).

Atlantis station 2999; Bahia de Matanzas, Cuba (lat. 23°10′ N., long. 81°29′ W.); 265–420 meters; March 17, 1938 [H. L. Clark, 1941].

Atlantis station 3303; off Playa Baracoa, Habana Province, Cuba (lat. 23°05′ N., long. 82°33′ W.); 475 meters; March 23, 1939 [H. L. Clark, 1941].

Atlantis station 3437; off the north coast of Santa Clara Province, Cuba (lat. 23°05′ N., long. 79°32′ W.); 475 meters; May 2, 1939 [H. L. Clark, 1941].

Atlantis station 3465; Bahia de Matanzas, Cuba (lat. 23°09′ N., long. 81°27′ W.); 320 meters; May 9, 1939 [H. L. Clark, 1941].

Atlantis station 3466; Bahia de Matanzas (lat. 23°09′ N., long. 81°27′30″ W.); 366 meters; May 9, 1939 [H. L. Clark, 1941].

Atlantis station 3467; Bahia de Matanzas (lat. 23°11′30″ N., long. 81°26′ W.); 393 meters; May 9, 1939 [H. L. Clark, 1941].

Atlantis station 3478; Bahia de Matanzas (lat. 23°09′ N., long. 81°27′30″ W.); 439 meters; May 11, 1939 [H. L. Clark, 1941].

Atlantis station 3479; Bahia de Matanzas (lat. 23°10′ N., long. 81°26′30″ W.); 384 meters; May 11, 1939 [H. L. Clark, 1941].

Atlantis station 3480; Bahia de Matanzas (lat. 23°10′ N., long. 81°28′ W.); 366 meters; May 11, 1939 [H. L. Clark, 1941].

Atlantis; off Playa Baracoa, Habana Province, Cuba; 475 meters (=station 3303) [H. L. Clark, 1941].

Atlantis; off Caibarien, Santa Clara Province, Cuba; 475 meters (=station 3437) [H. L. Clark, 1941].

Atlantis; off the north coast of Cuba; about 183 meters [H. L. Clark, 1941].

Caroline station 38; west of Puerto Rico (lat. 18°10′ N., long. 67°46′ W.); 402 meters; February 10, 1933 (1, U.S.N.M., E. 5251).

Blake station 269; off Milligan's Key, St. Vincent (lat. 13°07′55″ N., long. 61°05′36″ W.); 227 meters; bottom temperature 14.17° C.; coral; March 3, 1879 [von Graff, 1883, 1884; P. H. Carpenter, 1888] (106, M.C.Z., 305, 307, 308).

Blake station 232; off St. Vincent (lat. 13°06′45″ N., long. 61°06′55″W.); 159 meters; bottom temperature 16.67° C.; coral; February 21, 1879 [P. H. Carpenter, 1888; Hartlaub, 1912] (28, M.C.Z., 306).

?*Blake* station 249; off Grenada (lat. 11°48′15″ N., long. 61°48′45″ W.); 479 meters; bottom temperature 8.3° C.; coarse sand; February 27, 1879 [P. H. Carpenter, 1888; Hartlaub, 1912].

Caribbean Islands and Straits of Florida; 161–479 meters [P. H. Carpenter, 1888].

Geographical range.—From northern Cuba eastward and southward along the Antillean Chain to St. Vincent and ?Grenada.

Bathymetrical range.—From 159 to 479 meters; the average of 18 records is 370 meters.

Thermal range.—From 8.3° to 16.67° C.

History.—This species was first mentioned under the name *Antedon duplex*, a *nomen nudum*, by Prof. Ludwig von Graff who in 1883 listed it, as a host for myzostomes, from off St. Vincent in 124 fathoms (*Blake* station 269). Professor von Graff republished this notice in 1884.

Dr. P. H. Carpenter in the *Challenger* report upon the comatulids published in 1888 did not formally describe this species, though he mentioned it several times. He listed it as one of the few species having either 10 or more than 10 arms with the IIBr series 2, and inserted it in his key to the species of the *Spinifera* group with the characters over 30 cirrus segments, the later ones spiny; P_1 as long as or longer than P_2; centrodorsal rounded, the cirri without definite arrangement; 30–40 cirrus segments; the IBr axillaries long; and the lower segments of the genital pinnules expanded. He said that *Antedon* (*Stiremetra*) *lusitanica* differs from *duplex* in the shape of the axillaries and in the unmodified character of the genital pinnules, so far as can be determined from the condition of their fragmentary remains. He gave as the range "Caribbean Islands; Straits of Florida; 88–262 fathoms."

In 1895 Dr. Clemens Hartlaub discussed the systematic and bathymetrical relationships of this species, on the basis of the information given in the *Challenger* report, and compared it with his new species *Antedon* (*Thalassometra*) *agassizii*.

In 1905 Dr. Wilhelm Minckert discussed the syzygies and arm division of *Antedon duplex*, his specimens, received from Hartlaub, presumably having come from *Blake* station 232.

In my first revision of the old genus *Antedon* published in 1907 *duplex* was assigned to the new genus *Thalassometra*. In a revision of the family Thalassometridae published in 1909 I listed *Antedon duplex* among the species I was unable to place definitely because of lack of material for comparison. In his memoir on the comatulids of the *Blake* expeditions published in 1912 Hartlaub discussed this species in detail and figured it on the basis of three specimens from station 232. In my memoir on the crinoids of the *Siboga* expedition published in 1918 I listed *Horaeometra duplex* and gave the synonymy. I also inserted the new species *koehleri* in my key to the species of *Cosmiometra*, basing this new species on Hartlaub's figures 2 and 4 on plate 3, and 5 and 10 on plate 14, identified by him as *duplex*. These figures really represent *Horaeometra duplex* and not a species of *Cosmiometra*. In 1923 in my memoir on the crinoids of the *Ingolf* expedition I included *Horaeometra duplex* and gave the geographical and bathymetrical ranges.

In 1941 Dr. Hubert Lyman Clark recorded 42 specimens of *Horaeometra duplex* from 9 *Atlantis* stations and some other localities off the coast of Cuba in 145–240, and about 100, fathoms.

Family CHARITOMETRIDAE A. H. Clark

Basicurva group (in part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 102 (*Antedon basicurva*, *A. incisa*, *A. tuberosa*, *A. parvipinna*, *A. flexilis*, and *A. aculeata*); Journ. Linn. Soc. (Zool.), vol. 21, 1889, p. 308 (species compared with *Antedon* [*Pontiometra*] *andersoni*).—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 12 (diagnosis; range; 20 species), p. 14 (characteristic of the deep sea); Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 130 (revision, and arrangement of the included species according to depth), p. 136 (structural position).—Bather, Geol. Mag., dec. 4, vol. 3, 1897, p. 120 (pinnules compared with those of *Millericrinus recubariensis*).—Grieg, Bergens Mus. Aarbog for 1903 (1904), No. 5, p. 35.—Bell, Marine investigations in South Africa, vol. 4, 1905, p. 139

(description of a new species, *Antedon capensis* [= *Tropiometra carinata*], in reality a member of Carpenter's *Milberti* group).—MINCKERT, Arch. Naturg., Jahrg. 71, vol. 1, 1905, p. 207.—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, pp. 127, 128 (new species described); Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, pp. 343, 344 (characters differentiating this group not diagnostic), p. 345 (heterogeneous nature of the group), p. 348 (species with unplated disk and ambulacra assigned to *Nanometra*, gen. nov.), p. 359 (larger part of species included in *Thalassometra*, gen. nov.), p. 361 (most of the species not included in *Thalassometra* fall into *Charitometra*, gen. nov.); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 365 (included by Hartlaub and Minckert in a section of *Antedon* with side and covering plates, though some species are without them).

Acoela group (in part) P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 131 (*Antedon acoela* only; *A. discoidea* belongs to the Calometridae).—HARTLAUB, Nova Acta Acad. German, vol. 58, No. 1, 1891, p. 12 (diagnosis; range; 2 species), p. 14 (characteristic of the deep sea); Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 136 (structural position).—MINCKERT, Arch. Naturg., Jahrg. 71, vol. 1, 1905, p. 207.—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 128 (description of new species in this group); Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 343 (characters differentiating this group not diagnostic), p. 362 (*Poecilometra*, gen. nov., includes part of the species), p. 363 (*Calometra*, gen. nov., includes part of the species).

Spinifera group (in part) P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 211 (*Antedon flexilis*, *A. patula*, *A. robusta*, *A. pourtalèsi*, and *A. brevipinna; A. macronema* belongs to the Ptilometridae and *A. quinquecostata*, *A. spinifera*, *A. duplex*, *A. lusitanica*, and *A. compressa* to the Thalassometridae).—MINCKERT, Arch. Naturg., Jahrg. 71, vol. 1, 1905, p. 207; for further references see p. 1.

Granulifera group (in part) P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 239 (*Antedon angusticalyx*, *A. inaequalis*, *A. granulifera*, and *A. distincta; A. multispina* and *A. porrecta* belong to the Thalassometridae); Journ. Linn. Soc. (Zool.), vol. 21, 1889, p. 308 (species compared with *A.* [*Pontiometra*] *andersoni*).—HARTLAUB, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 13 (diagnosis; range; 6 species).—BELL, Proc. Zool. Soc. London, 1894, p. 398 (description of *Antedon inopinata*, sp. nov. [= *Himerometra robustipinna*, Himerometridae]).—HARTLAUB, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 136 (structural position).—GRIEG, Bergens Mus. Aarbog for 1903 (1904), No. 5, p. 85.—MINCKERT, Arch. Naturg., Jahrg. 71, vol. 1, 1905, p. 207.—A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, pp. 343, 344 (characters differentiating this group not diagnostic), p. 359 (one species included in *Thalassometra*, gen. nov.), p. 361 (most of the species not included in *Thalassometra* fall in *Charitometra*, gen. nov.).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, pp. 285, 286.

Brevipinna group MINCKERT, Arch. Naturg., Jahrg. 71, vol. 1, 1905, p. 225.—A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 344 (history and definition); Vid. Medd. Nat. Foren. København, 1909, p. 146 (criticism; in reality non-existent).

Savignyi group (in part) BELL, Marine investigations in South Africa, vol. 4, 1905, pp. 140, 141 (descriptions of two new species, *Antedon sclateri* and *A. magnicirra*).

Thalassometridae (part) A. H. CLARK, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 136; Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211.

Charitometrinae A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 2 (definition and comparisons), p. 18 (revision of the included genera); Vid. Medd. Nat. Foren. København, 1909, p. 146 (variation in the IIBr series in West Indian species); Mem. Australian Mus., vol. 4, 1911, p. 728 (raised to family rank); Journ. Washington Acad. Sci., vol. 5, No. 4, 1915, pp. 126–134 (phylogenetical and paleontological significance of the bathymetrical range).

Charitometridae A. H. CLARK, Mem. Australian Mus., vol. 4, 1911, p. 728 (Charitometrinae raised to family rank); Crinoids of the Indian Ocean, 1912, p. 6 (number of East Indian genera also represented in the Atlantic, number represented in the Atlantic by closely allied genera, and number confined to the East Indies; number of East Indian species), p. 10 (greatly developed in Japan), p. 11 (occurs both east and west of Ceylon), p. 12 (represented in the Red Sea region by *Pachylometra*, in the southeast African region by the same), p. 13 (East Indian and corresponding West Indian genera), p. 14 (characterisitc of the Intermediate fauna, but one species comes within 30 fathoms of the surface), p. 24 (range in detail; closely parallels the range of the Thalassometridae, average depth about the same, but no species descend so deep or come so near the surface), p. 42 (raised to family rank from a subfamily), pp. 45, 49, 51, 53 (in keys), p. 60 (key to the included genera).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 286 (discussion).—Springer and Clark, Zittel-Eastman's Paleontology, 1913, p. 236 (in the Oligophreata).—A. H. Clark, Bull. Inst. Océanographique, Monaco, No. 294, 1914, pp. 7, 8 (temperature relations); Journ. Washington Acad. Sci., vol. 4, No. 19, 1914, pp. 559–563 (correlation of geographical and bathymetrical ranges); No. 20, 1914, p. 582 (relation to temperature of habitat); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1914, pp. 4 and following (Atlantic and corresponding Indo-Pacific genera); Die Crinoïden der Antarktis, 1915, p. 132 (covering plates compared with those in the Heliometrinae), p. 164 (represented in South Africa by *Pachylometra sclateri*); Amer. Journ. Sci., vol. 40, 1915, p. 67 (detailed philosophical discussion of bathymetrical range); Smithsonian Misc. Coll., vol. 65, No. 10, 1915, pp. 43 and following (phylogenetical study); Unstalked crinoids of the *Siboga* Exped., 1918, p. 171 (key to the included genera); Journ. Washington Acad. Sci., Vol. 9, No. 5, 1919, p. 136 (arm bases compared with those of *Holopus*); Univ. Iowa Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (represented in the West Indies); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, pp. 3, 13.—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 10, 119.—A. H. Clark, The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40.—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 19 (arm structure), pp. 42, 44, 73, 80, 84, 85, 88, 90, 94, 100, 231, 239, 280, 284; Vid. Medd. Dansk Naturh. Foren. København, vol. 83, 1927, pp. 33, 38; Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, pp. 8, 9.—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 655.—Gislén, Vid. Medd. Dansk Nat. Foren. København, vol. 93, October 26, 1933, pp. 481, 482.—A. H. Clark, Treubia, vol. 14, livr. 2, December 1933, p. 214.—Gislén, Kungl. Fysiograf. Sällsks. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20, 22, 23.—A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, 1937, pp. 101, 103.—Gislén, Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, October 3, 1938, pp. 4, 18.—H. L. Clark, Mem. Soc. Cubana Hist. Nat., vol. 15, No. 1, May 1941, p. 9.—A. H. Clark, Bernice P. Bishop Mus. Bull. 195, 1949, p. 75.

Charitometriden A. H. Clark, Die Crinoïden der Antarktis, 1915, p. 192 (species and genera of this family especially characteristic of the Intermediate fauna).

Diagnosis.—A family of the superfamily Tropiometrida in which the ventral perisome of the pinnules is protected by well-developed and conspicuous side and covering plates easily visible with a hand lens; P_1 and P_2 are similar (in small species P_2 may be like P_3), of about the same length as the following pinnules, sometimes somewhat longer or shorter, but more slender and flexible and composed of a large number of short segments; and the cirri are short, stout, and strongly curved, composed of usually less than 25 segments of which the outer are little, if at all, shorter than the earlier and bear no dorsal processes though they may be carinate or rise into low broadly rounded tubercles at the distal end; there is no transition segment and all the segments are similarly dull in color.

Geographical range.—From southern Japan, the Hawaiian Islands, Fiji, the Kermadec Islands, the Sahul Bank, and Timor westward to east Africa, from Sokotra southward to East London; St. Helena; from the Yucatán Bank, the Florida Keys, northern Cuba, and the southern Bahamas eastward and southward to Barbados and Grenada.

Bathymetrical range.—From 55 to 2,194 meters.

Thermal range.—From 4.17° to 18.20° C.

Remarks.—Because of the singularly uniform structure of all the species in this family, particularly the similarity of the oral pinnules and of the cirri throughout, the delimitation of natural genera within the group has proved to be a matter of no little difficulty. Twelve genera have been established, many of them based on characters that have proved to be unreliable, some of them of at most only specific significance, some even inconstant within a single species.

The first genus established, *Charitometra* (genotype *Antedon incisa*), was essentially the equivalent of the family Charitometridae as now understood, except for the exclusion of the species of the genus *Poecilometra* (genotype *Antedon acoela*) established at the same time, and the inclusion of *Antedon compressa* and *A. orion* which are now assigned to the genus *Parametra* in the family Thalassometridae. The genus *Poecilometra* was separated on the basis of the concave sides of the elements of the IBr series, their produced and flangelike dorsolateral edges, and the much expanded genital pinnules. In separating *Poecilometra* from *Charitometra* I was influenced by the fact that Carpenter had made his *Antedon acoela* the type of a special group, the *Acoela* group, in which he also included *Antedon discoidea*, a species of the family Calometridae. He defined the *Acoela* group as having "The rays not flattened laterally. Pinnule ambulacra well plated."

In 1909 I established the subfamily Charitometrinae and gave a key to the seven included genera, five of which were diagnosed for the first time. The first division included genera in which the IBr series and lower brachials have produced or everted edges forming a thin flangelike border. *Poecilometra* was distinguished by having the dorsal edges also produced, the genital pinnules greatly and abruptly expanded, and the IBr series and brachials rounded dorsally without ornamentation. In *Glyptometra* (genotype *Antedon tuberosa*) the IBr were said to have only the dorsolateral edges produced, the genital pinnules very regularly expanded and evenly tapering, and the IBr series and lower brachials with the dorsal surface rugose or tubercular. The second division included genera in which the IBr series and lower brachials do not have the dorsolateral edges produced. In one section the included genera have the third and fourth segments of the genital pinnules broad and nearly flat on the outer side, but the fifth segment smaller. This section included *Strotometra* (genotype *Antedon hepburniana*) with less than 12 cirrus segments and the IBr series and arm bases diverging at a wide angle, and *Charitometra* with more than 15 cirrus segments and the IBr series and arm bases diverging at a relatively small angle. The other section included genera with the genital pinnules evenly and only slightly expanded. There were three divisions of this section. In one the lower pinnules were said to be twice as long as the middle pinnules; this included *Crinometra* (genotype *Comatula brevipinna*). In the other section the lower and middle pinnules were said to be of approximately the same length. This section included *Pachylometra* (genotype *Antedon distincta*) in which the cirri were said to be large and stout with 18 or more segments, and *Chlorometra* (genotype *Antedon garrettiana*) in which the cirri are weak and slender with 16 or fewer segments.

In his excellent memoir on the comatulids of the *Blake* Expedition published in 1912 Dr. Clemens Hartlaub had considerable difficulty with the interrelationships of the species of this family. He used Carpenter's classification instead of my new classification then in process of development for the reason, as he told me, that he was simply completing a work begun by Carpenter and therefore felt himself bound to follow Carpenter's original plan. He identified two specimens from *Blake* station 157 as *Antedon angusticalyx*, but said that they stand between *A. angusticalyx* and *A. inaequalis*. But in the larger of these specimens P_D is 11 mm. long with about 30 segments, P_1 is

6–7 mm. long with 15–18 segments, and the genital pinnules are mostly 5–6 mm. long with 9–14 segments; these proportions are very different from those of the pinnules of either *angusticalyx* or *inaequalis*, and agree with those of other forms in the genus *Crinometra*.

In 1916 I established five new genera (see Part 3, page 58) as follows: *Crossometra* (genotype *Pachylometra septentrionalis*) with the cirri arranged in 10 columns on the centrodorsal and 26–33 arms; *Perissometra* (genotype *Antedon flexilis*) with the cirri arranged in 10 columns on the centrodorsal and 10–20 arms; *Monachometra* (genotype *Pachylometra fragilis*) with the cirri arranged in 15 columns on the centrodorsal, all the division series 2, and the division series and first two brachials rising rather sharply to a blunt keel; *Calyptometra* (genotype *Charitometra lateralis*) with the lateral borders of the elements of the division series and first four brachials strongly everted and with a blunt median keel, the proximal pinnules somewhat longer and more slender than their successors, and 10, rarely 11 arms; and *Chondrometra* (genotype *Chlorometra robusta*) with the arms in their outer portion as well as the IBr series and arm bases strongly compressed laterally and rising dorsally into a rooflike keel, with 10 arms, with the cirri in 5 or 10 columns, and with the proximal pinnules about as long as those succeeding.

In my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 I recognized the genera *Crinometra*, *Strotometra*, *Poecilometra*, *Charitometra*, *Chondrometra*, *Glyptometra*, *Crossometra*, *Perissometra*, *Monachometra*, *Pachylometra*, *Calyptometra*, and *Chlorometra*. A key to these was given, using the characters given above.

In his paper on the crinoids collected by Dr. Th. Mortensen in Japan Prof. Torsten Gislén pointed out some inconsistences in my classification. He said it seemed to him very doubtful whether *Glyptometra* and *Perissometra* can be maintained as sharply differentiated genera. He noted that as at first diagnosed *Glyptometra* included some species now referred to *Perissometra*, a later genus. He remarked that the chief difference between *Perissometra* and *Glyptometra* is said to be that the former has on the brachials "a blunt median carination . . . never a low sharp median keel . . . proximal and distal borders of the ossicles of the division series and the lower brachials never everted and standing up at right angles to the general surface of the segments." But he noted that I said *Perissometra patula* has the "ossicles of the division series and brachials each with a broad low inconspicuous keel which persists to the ends of the arms; distal edges of the discoidal brachials beyond the second prominently and abruptly everted, of the more distal triangular brachials produced and overlapping"; and I also said of *P. lata* that "the median portion of the ossicles of the IBr series and first two brachials is abruptly raised into an irregular rounded tubercle . . . the proximal and distal borders are more or less irregularly crenulate." The difference in the ornamentation between *Glyptometra* as typified by *G. tuberosa* and *Perissometra* as represented by *P. patula* and *P. lata* is really strongly marked, though it was perhaps poorly described. Nevertheless, his point is well taken, and the difference in ornamentation affords no good grounds for generic separation. He quite rightly remarked that the limit between the two genera is obscure, but suggested that perhaps one should, however, be able to retain the two genera in a somewhat altered sense; *G. tuberosa* is said to have the cirrus segments provided with a dorsal keel, while on the other hand the species of *Perissometra* usually have no dorsal spine. With such a limitation, he said, *tuberosa* and *patula* must be referred to *Glyptometra*, and so must *lata*, *crassa*, and perhaps also other species now referred to *Perissometra*.

In 1927 Gislén recorded specimens of *Perissometra aranea*, which he had described in 1922, and described *P. carinata* and *Monachometra mortenseni*, all three of which are based upon specimens of *Parametra orion*, a species of the family Thalassometridae. In 1928 after examining the *Challenger* material in the British Museum he published various notes on the classification of the Charitometridae. He said that the genus *Parametra* must be referred to the Charitometridae, repeating the error I had made in my original diagnosis of the genus *Charitometra* to which I referred *Antedon compressa* and *A. orion*, both species of *Parametra*. He noted that Carpenter's *Antedon distincta*, which I referred to the genus *Pachylometra*, must be referred to *Crossometra*, as it has the cirri arranged in 10 columns. Under *Perissometra angusticalyx* he said that *Perissometra* is indistinctly separated from *Crossometra;* all *Perissometras* with the IIBr series 4(3+4) should be referred to *Crossometra*, leaving in *Perissometra* 10-armed forms and those with the IIBr 2—*patula*, *timorensis*, *lata*, *flexilis*, and *aranea* (the last=*Parametra orion*). He noted that two widely different forms are included under *Perissometra patula*. One specimen with only 10 arms, as is often the case the larger one, has the centrodorsal discoidal, the cirri stout, arranged in 12 columns, the segments with a dorsal spine and keel, and a simple opposing spine. In the other, which seems to be the same type as described and figured by Carpenter, the centrodorsal is sharply conical with the cirri in 10 columns, the cirrus segments without dorsal spines, the opposing spine forked, and the brachials collar-shaped; the arms, he said, were very similar to those of his *Diodontometra*=*Chlorometra*), but the arrangement of the cirri is different; the cirrus sockets are striated, just as in some fossil comatulids. He said that the first type should be referred to *Monachometra*. Under *Perissometra flexilis* he said that the subdivision of the genus *Perissometra* into species with more or less than 13 arms is not suitable. Under *Monachometra robusta* he said that this species, considered by me to be a *Perissometra*, must be referred to *Monachometra*. He remarked that *Charitometra* and *Poecilometra* are closely related. The flanges on the proximal pinnules are rather similar. The difference of the basicurvity is, however, noticeable. He suggested the following differences: (*a*) Arm bases well separated, *Poecilometra;* (*b*) Arm bases flattened and close to each other, *Charitometra*. He said that *Strotometra parvipinna* ought to be referred to *Perissometra* and is perhaps the same as his *P. aranea*.

In conclusion Professor Gislén said he thought it evident from the examples given that the family Charitometridae is still not satisfactorily subdivided. It seemed to him that I had laid too much stress on the ornamentation of the arms. He believes that the cirri offer quite as good or even better differential characters. In many cases they are exceedingly characteristic, and evidently they are much less subject to variation than the ornamentation. He said that there are at least two very distinct types of cirri within the family: (1) Stout cirri lacking dorsal spines, and (2) Slender cirri with distal dorsal spines. The former may have or lack an opposing spine which is, besides, often transverse or even bisected. Though in the former case the cirri are devoid of dorsal spines the segments may possess a faint longitudinal crest. He believed that by considering these characters we may find it much easier to subdivide the family so as more correctly to indicate interrelationships.

In 1933 when describing *Crinometra transversa* from St. Helena Professor Gislén wrote that when I established the genus *Crinometra* I distinguished it from the related genus *Pachylometra* by the very long proximal pinnules, which should be very strongly carinate, and by the proportionately short middle and distal pinnules, which were said to be not quite half as long as P_1. The genital pinnules should be more abruptly expanded than those of *Pachylometra*. Besides, there should appear in *Crinometra* overlapping brachials and usually tuberculation of the basal portions of the arms. He said that in 1918 I considered the difference in length between the proximal and middle pinnules, together with the proximal carination of the former, the chief distinguishing feature between *Crinometra* and the remaining genera of the Charitometridae. He said that in fact the overlapping of the brachials, the expansion of the pinnules, and the tuberculation of the arm bases are so variable or indefinite characters within *Crinometra* that they certainly cannot be used for generic characterization. He remarked that the question is whether the character of the middle pinnules, being not quite half so long as P_1, may be used as a distinguishing mark for *Crinometra*. When studying Hartlaub's treatise on the varieties of *Crinometra brevipinna* (1912) he found the following statements. In var. *elegans* P_1 is 10–12 mm. long, and the middle pinnules are 7 mm. long; in var. *diadema* P_1 is 8 mm. long, and the middle pinnules are 5 mm. long. He said he had found the same proportions in a specimen of *Crinometra insculpta* borrowed from the Copenhagen Museum that had been identified by me. He noted that, on the other hand, short middle pinnules may occur in species of Charitometridae that do not fall in *Crinometra*, as for instance in *Perissometra aranea*, *P. carinata*, and *Monachometra mortenseni*. He remarked it is clear that this feature cannot be used alone for distinguishing *Crinometra*. But *Perissometra aranea*, *P. carinata*, and *Monachometra mortenseni* belong not to the Charitometridae but to the Thalassometridae, all three being synonyms of *Parametra orion* (see page 72). Gislén wrote it might be asked whether the feature of the long proximal pinnules may not be used together with other distinguishing characters. He said that the carination of the proximal pinnules may be a rather good character, but in some forms referred to this genus it is poorly developed and very insignificant, for instance in *granulifera*. The tuberculation in some forms is very characteristic and apparent, but is lacking in others. He said that therefore either some forms with smooth arm bases should be excluded from the genus, as *C. pulchra*, or this feature should not be used as a generic character. He regarded the tuberculation of the arm bases as of small systematic significance. He said that the large number of segments in the proximal pinnules, 20–40, as compared with those of the middle pinnules, 10–15, may be generically important, but similar conditions seem to occur also in some Pachylometras and Perissometras. But in these the length of the middle pinnules does not seem to decrease. In this connection he said it is to be regretted that our knowledge of the proportions of the proximal pinnules is very scanty, especially as regards the more recently described species.

Since *Crinometra transversa*, as well as some of the forms of *Crinometra* previously known, cannot be separated as a group of species which can possibly be distinguished from other Charitometridae, he said that either *Crinometra* must be given up or it must be provided with an emended diagnosis. The facts seem to speak in favor of the latter solution, and it may be possible to distinguish the genus in the following manner: *Crinometra* is a genus of the Charitometridae in which the centrodorsal is a thick disk;

the cirri are up to XX, 15–25; the cirrus sockets, in mature individuals, are arranged in about 15 crowded columns; the IBr_1 is very short; the IIBr series are 2 or 4 (3+4); the IIIBr series, when present, are 2, developed internally; and the first two brachials are united by syzygy, at least after a IIBr 4(3+4) series, or a IIIBr series; P_1 and P_2 are the longest pinnules on the arm, with more than 20 segments; the pinnules then rapidly decrease in length, the middle pinnules being about three-fourths or half the length of the proximal ones; the genital pinnules are moderately expanded over a number of segments. He said that within these limits *Pachylometra inaequalis* must be included in the genus, and perhaps *P. levigata* also. He remarked that *Pachylometra distincta*, which in 1909 I made the type of *Pachylometra*, is in reality a *Crossometra*, as pointed out by him in 1928; *Crossometra* therefore becomes a synonym of *Pachylometra*.

In reviewing the 13 genera at present accepted in the family Charitometridae it was found that much confusion existed. Several of the genera were based upon characters of minor importance, or so variable as to be unreliable and undiagnostic. These characters were chiefly those found in the arms, especially the type of arm division and ornamentation; the type of genital pinnules; the length of the oral pinnules; the distribution of the cirrus sockets; and the number of cirrus segments. The characters presented by the details of the cirri were disregarded; they were overlooked because of the singularly uniform general appearance of the cirri throughout the family.

The number of arms is of little significance. Several genera include only species with 10 arms, in others the included species may have 10 or more than 10 arms, in still others the number of arms appears always to be more than 10. In a few genera the IIBr series are always 2, but in most they are chiefly 4(3+4), more rarely 2, though in some individuals all the IIBr series present may be 2. Although in a few species, as in *Glyptometra tuberosa*, ornamentation is always present and characteristic, in most of the species in which it occurs it is highly variable. The extreme is reached in *Crinometra brevipinna* in which some individuals have the most highly developed and complex ornamentation to be found in the family while others are entirely plain. Sometimes the adults will have a characteristic ornamentation though the young are plain. But strong lateral compression of the arms combined with carination involving the whole dorsal surface is a reliable feature. The characters presented by the genital pinnules seem to be reliable. In many species, however, these are variable, the genital pinnules of some individuals being almost or quite unmodified, of others much swollen. In individuals of some forms of *Crinometra brevipinna* the genital pinnules have the third and fourth segments abruptly expanded as in *Strotometra*, though the slender portion beyond these is always much longer than the swollen part. There appears to be in general a line of demarcation between the species with the cirri in 10 columns on the centrodorsal and those in which the cirri are in 15 or 5 columns; but in some, as *Glyptometra inaequalis*, they may be in either 10 or 15 columns, in some they may be in 10, 11, or 12 columns, and in others they are in 10 columns in young individuals and in 15 in the fully grown.

Of the genera heretofore recognized five seem to be without valid significance. *Diodontometra* is based upon the new species *D. bocki* which is a synonym of *Antedon garrettiana*, the type species of the genus *Chlorometra*. *Pachylometra* as defined is characterized in part by having the cirri in 15 columns on the centrodorsal, though the central column may be wholly or partially absent. After examining an example of the type species, Carpenter's *Antedon distincta*, in London, Gislén found that the cirri are arranged in 10 columns. This is the chief character of *Perissometra*, which therefore becomes a synonym of it. *Pachylometra* offers no other features other than details of ornamentation by which it may be separated from *Glyptometra*. It therefore has no standing. *Crossometra* differs from *Perissometra* only in having a greater number of arms, a wholly unreliable feature. *Calyptometra* was distinguished mainly on the basis of the type of ornamentation of the division series and arm bases, a character of wholly minor significance. The elimination of these genera leaves eight genera in the family which seem worthy of recognition—*Chondrometra*, *Monachometra*, *Glyptometra*, *Crinometra*, *Chlorometra*, *Charitometra*, *Poecilometra*, and *Strotometra*.

There seems to be a clear-cut dividing line between the groups of species in which the genital pinnules taper from the usually more or less broadened earlier segments to a delicate tip which is always much longer than the gonads, and those in which the genital pinnules have from two to four segments much broadened, followed by a slender tip which is shorter than the gonads. In the first category the group with the division series and arms much compressed laterally and rising evenly dorsally to a ridge, *Chondrometra*, seems to be quite distinct from the group in which the arms are rounded dorsally, with or without a median raised line. In the latter group *Crinometra* is distinguished by the relatively long oral and short genital pinnules. In *Monachometra* and *Glyptometra* the oral and middle pinnules differ little or not at all in length. In *Monachometra* there are narrow and strongly developed synarthrial tubercles, the IIbr series are always 2, and the opposing spine is forked, whereas in *Glyptometra* the synarthrial tubercles are slightly or not at all developed, the IIBr series are usually 4 (3+4), sometimes 2, and the opposing spine is single. In the group with the genital pinnules much swollen at the base and with a short distal portion, the long conical centrodorsal with the cirri in five double midradial columns, the opposing spine forked, and about 20 arms with the IIBr series 2 distinguishes *Chlorometra*. In *Chlorometra* the genital pinnules are not so abruptly and greatly swollen as they are in the other members of this group and they may not be swollen at all, though the genital segments are usually enlarged. The genital pinnules of *Chlorometra* are very little different from those of *Monachometra*, of which *Chlorometra* should perhaps be regarded as a synonym. Although the arrangement of the cirri in *Chlorometra* appears to be distinctive, it is probably no more distinctive than it is in *Chondrometra* in which the cirri are arranged in 5 midradial columns in *C. robusta* and *C. aculeata*, but in 10 columns in *C. rugosa*. In the other genera the centrodorsal is hemispherical or discoidal with the cirri in irregular marginal rows and only 10 arms. The widely divergent arm bases and small size distinguish *Strotometra*, while the compressed arm bases of *Charitometra* are closely appressed and flattened against each other, those of *Poecilometra* not in contact and more or less concave.

Of the eight recognized genera of the Charitometridae, five, *Chondrometra*, *Monachometra*, *Chlorometra*, *Poecilometra*, and *Strotometra*, are, as far as is now known, confined to the region between southern Japan and the Lesser Sunda Islands; one, *Charitometra*, is known only from the Kermadec Islands and Fiji; one, *Glyptometra*, covers the entire range of the family in the Pacific and Indian Oceans, while the closely related *Crinometra* represents the family in the Caribbean region and at St. Helena.

The family Charitometridae is closely allied to the family Thalassometridae, but it represents a more generalized type. The cirri are less specialized, lacking the polished spine-bearing segments beyond the transition segment characteristic of the Thalassometridae. They may be said to correspond to the cirri of the Thalassometridae as far as the transition segment, for the penultimate segment often has a polished distal end like the transition segment of the Thalassometridae. The oral pinnules of the Charitometridae are usually about as long as the pinnules following, but are more slender and flexible with much more numerous short segments. They are less modified than the elongate and basally stout oral pinnules of the Thalassometridae. In the Charitometridae there are usually two pairs of oral pinnules except in very small species while in the Thalassometridae there is only a single pair except in some large species in which the second pair may be more or less intermediate. Similarly the genital pinnules are more generalized than those of the Thalassometridae, being longer and in most cases more like the distal pinnules. The pinnules in general are not so much stiffened as are those of the Thalassometridae. In the family Thalassometridae there is an approach to the Charitometridae in the genus *Parametra* in which the cirri have only a few segments beyond the transition segment, and P_1 is not greatly longer or stouter than the pinnules following.

The genera of the Charitometridae do not fall into distinctive groups as do those of the Thalassometridae, but the first group in this family, with the arms strongly compressed laterally and sharply carinate, finds a parallel in the genus *Chondrometra.* The genera with the genital pinnules abruptly swollen are not so sharply differentiated from the others as they are in the Thalassometridae.

The family Charitometridae is less widely distributed than the Thalassometridae, not extending, so far as is now known, to the Aleutian or Galápagos Islands, southeastern Australia, or the Crozets, nor does it occur in the Atlantic basin except in the Caribbean and at St. Helena. Its bathymetrical and thermal ranges are also considerably less.

History.—The species now included in the family Charitometridae were distributed by Dr. P. H. Carpenter among the *Basicurva* group, the *Acoela* group, the *Spinifera* group, and the *Granulifera* group. In 1905 Minckert diagnosed the *Brevipinna* group the type species of which is the same as that of Carpenter's *Granulifera* group. In 1905 Prof. F. Jeffrey Bell described a species of this family, and another of the family Thalassometridae, in Carpenter's *Savignyi* group.

In 1907 I segregated all the described species now considered as belonging to this family in the genera *Charitometra* and *Poecilometra* (see Part 3, p. 8). In a paper published on April 11, 1908, I distributed the living comatulids among several families, assigning the genera *Charitometra* and *Poecilometra* to the family Thalassometridae. In a paper written considerably in advance of this though not published until May 14 (see Part 3, p. 15) the same arrangement is suggested. In 1909 the genera *Charitometra* and *Poecilometra*, together with the new genera *Glyptometra, Strotometra, Pachylometra, Chlorometra,* and *Crinometra,* were segregated as a new subfamily Charitometrinae of the family Thalassometridae (see Part 3, p. 33). In my memoir on the recent crinoids of Australia published in 1911 the subfamily Charitometrinae was raised to family rank and designated as the family Charitometridae.

KEY TO THE GENERA OF THE FAMILY CHARITOMETRIDAE

a^1. Genital pinnules tapering evenly from the usually more or less broadened earlier segments to a delicate tip, the portion beyond the gonads being much longer than the gonads themselves.

b^1. Outer portion of the arms strongly compressed laterally, the dorsal surface rising evenly into a more or less sharp keel in the middorsal line, the keels on each brachial forming a high overlapping spine or tubercle; ossicles of the division series and first two brachials with the central portion elevated, V-shaped in cross section; centrodorsal more or less columnar, the cirrus sockets in 5 or 10 columns; 10 arms 75–211 mm. long (southern Philippines to Timor; 520–1,334 meters)---------- **Chondrometra** (p. 201)

b^2. Outer portion of the arms rounded dorsally, with or without a fine median abruptly raised line.

c^1. Oral pinnules little or not at all longer than the middle and distal pinnules.

d^1. Ossicles of the division series rising to a prominent narrow, high, smooth, and pointed synarthrial tubercle the profile of which forms an acute angle; IIBr series 2; opposing spine often or usually forked (Philippine Islands southward to the Kei Islands and the Sahul Bank; 104–704 meters)---------- **Monachometra** (p. 208)

d^2. Synarthrial tubercles, if present, low and broadly rounded, the profile a broadly rounded obtuse angle; IIBr series 4(3+4), occasionally 2; opposing spine never forked (western Indian Ocean from Sokotra south to East London, South Africa, and eastward to Timor, the Sahul Bank, the Kermadec Islands, Fiji, and the Hawaiian Islands, and northward to southern Japan; 55–2,194 meters)---------- **Glyptometra** (p. 227)

c^2. Oral pinnules markedly longer than the very short middle and distal pinnules (from the Yucatán Bank, the Florida Keys, northern Cuba, and the southern Bahamas eastward and southward to Barbados and Grenada; also St. Helena; 139–707 meters).
Crinometra (p. 279)

a^2. Genital pinnules with from two to four segments much broadened, the broadening ending abruptly and being succeeded by a slender distal portion shorter than the much swollen and prominent ovoid gonads; size medium or small, the arms not over 110 mm. and usually less than 100 mm. in length.

b^1. Centrodorsal sharply conical, higher than broad at the base, with the cirrus sockets in 5 columns, single or partially double, one in the middle of each radial area, the columns being separated by broad interradial spaces; 14–20 arms 60 mm. long, the IIBR series 2; opposing spine forked (southwestern Japan to the Bonin Islands; 165–210 meters)---------- **Chlorometra** (p. 221)

b^2. Centrodorsal hemispherical or discoidal, much broader at the base than high, with the cirrus sockets in irregular marginal rows, not segregated into distinct columns; 10 arms.

c^1. Division series and arm bases compressed, their profile making a small angle with the dorsoventral axis; at least 15 cirrus segments; larger, the arms 90–110 mm. long.

d^1. Ossicles of the division series and lower brachials in close lateral contact, without modified lateral borders, and broadly and sharply flattened against their neighbors (Kermadec Islands to Fiji; 1,152 meters)---------- **Charitometra** (p. 347)

d^2. Ossicles of the division series and lower brachials relatively narrow and well separated from their neighbors, the gap between them more or less completely bridged by a thin flange-like production of the dorsolateral margin of the ossicles which persists as far as the fourth or fifth brachials (Celebes to Mindanao; southwestern Japan; 660–1,327 meters).
---------- **Poecilometra** (p. 354)

c^2. Division series and arm bases more or less recumbent, their profile making a large angle with the dorsoventral axis; not more than 15 cirrus segments; smaller, the arms not over 75 mm., and rarely over 45 mm., long (Timor and the Kei Islands northward to southwestern Japan; 180–1,165 [?1,264] meters)---------- **Strotometra** (p. 361)

Genus CHONDROMETRA A. H. Clark

Antedon (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 128, and following authors.

Charitometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361.

Chlorometra (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 22.—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Pap. 90–L, 1915, p. 195 (inorganic constituents of the skeleton); Prof. Pap. 102, 1917, pp. 23 and following (same); Prof. Pap. 124, 1922, p. 20 (same).

Chondrometra A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 608 (diagnosis; genotype *Chlorometra robusta* A. H. Clark, 1911; range; included species).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 172 (in key; range), p. 187 (key to the included species).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.

Diagnosis.—A genus of Charitometridae in which the genital pinnules taper evenly from the more or less broadened earlier segments to a delicate tip, the portion beyond the gonad being much longer than the gonad itself; the division series and arms are V-shaped in cross section, rising evenly to a more or less sharp median keel, the keel on each of the outer brachials forming a high overlapping spine or tubercle; the centrodorsal is conical or columnar with the cirrus sockets in 5 or 10 definite columns; and the arms are 75–211 mm. long.

Geographical range.—From Timor northward to the southern Philippines.

Bathymetrical range.—From 520 to 1,334 meters.

Thermal range.—From 4.77° to 13.55° C.

Remarks.—The laterally compressed and carinate arms make the species of this genus easy to recognize. Of the three species herein referred to *Chondrometra* one, *rugosa*, seems to be quite distinct; the other two, *robusta* and *aculeata*, are separated on characters that may prove to be due merely to differences in the degree of maturity.

History.—The first known species of this genus, *aculeata*, was described by Dr. P. H. Carpenter in 1888 under the generic name of *Antedon*. In 1907 I transferred it to the new genus *Charitometra*. In 1909 I assigned it to the genus *Chlorometra* of which the genotype was *Antedon garrettiana* A. H. Clark, 1907. In 1916 I established the genus *Chondrometra* with the genotype *Chlorometra robusta* A. H. Clark, 1911, and including also *Chlorometra rugosa* (a *nomen nudum*, described in 1918 as *Chondrometra rugosa*) and Carpenter's *Antedon aculeata*.

KEY TO THE SPECIES IN THE GENUS CHONDROMETRA

a^1. Centrodorsal very large, truncated conical or more or less columnar, with the cirrus sockets arranged in 10 regular columns, two, more or less widely separated in the midradial line, in each radial area; cirri short, one-sixth of the arm length, XXX, 18–19, 35 mm. long; arms 210 mm. long (Celebes southward to the East Timor Sea; 520–871 meters) .... **rugosa** (p. 206)

a^2. Centrodorsal small or of medium size, sharply conical, with the cirrus sockets arranged in 5 more or less regular columns, one in the midline of each radial area; cirri longer, from one-fourth to one-third the arm length.

  b^1. Size large, the arms 170–211 mm. long; cirri numerous with numerous segments, XX–XXV, 26–28, 55–60 mm. long (southern Philippines southward to the East Timor Sea; 520–1,334 meters) .... **robusta** (p. 202)

  b^2. Size small, the arms 75 mm. long; cirri less numerous with fewer segments, XV, 18, 27 mm. long (Meangis Islands; 914 meters) .... **aculeata** (p. 204)

CHONDROMETRA ROBUSTA (A. H. Clark)

Plate 19, Figure 60

[See also vol. 1, pt. 1, fig. 207, p. 239.]

Chlorometra robusta A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 558 (description; *Albatross* station 5348; also station 5349; comparison with *Ch. aculeata*); Crinoids of the Indian Ocean, 1912, p. 225 (synonymy; locality).

Chondrometra robusta A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 608 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 188 (in key; range), p. 189 (references; notes; station 297), fig. 9, p. 189, p. 275 (listed).

Diagnostic features.—The centrodorsal is sharply conical, as high as broad at the base, with the cirrus sockets arranged in 5 more or less regular often partially double midradial columns; the arms are 170–211 mm. long; and the cirri are long with numerous segments, up to 60 mm. in length with up to 28 segments. This may be only the fully mature form of *Ch. aculeata.*

Description.—The centrodorsal is long, conical, about 6 mm. broad at the base and 6 mm. high. The cirrus sockets are confined to the midradial regions where they are arranged in two very closely crowded converging alternating columns, which merge and become a single column distally. There are four or five cirrus sockets in each radial area.

The cirri are stout and very long, XX–XXV, the peripheral with 26–28 segments from 55 to 60 mm. in length, those near the apex of the centrodorsal with 21 segments and from 35 to 40 mm. long. The first segment is short and those following increase in length becoming approximately as long as broad on the sixth and from the eighth onward about twice as long as broad. The distal dorsal edges of the segments are somewhat thickened, especially in the outer half of the cirri. The penultimate segment is slightly less in diameter than those preceding. The opposing spine is very small, terminal. The terminal claw is about as long as the penultimate segment, slender, and slightly curved. The cirri are moderately compressed laterally.

The 10 arms are 211 mm. long. The arm bases and arms are essentially as in *C. aculeata,* but much more rugged. The IBr_2 (axillary) has a prominent dorsoventrally elongate well-rounded tubercle. The second brachial is similar. The following brachials as far as the fourteenth have prominent rounded median tubercles as long as the segments. After the fourteenth brachial these tubercles become high, thick, overlapping spines, the bases of which occupy the entire dorsal median line of the segments. Terminally these spines gradually decrease in height and eventually disappear.

The genital pinnules are expanded as in *Glyptometra tuberosa.*

Notes.—Two smaller specimens were secured with the type just described. One of these is about the size of the type of *C. aculeata,* from which it is easily distinguished by the much longer and more sharply conical centrodorsal and by the dorsal ornamentation of the arms which, though not so developed as in the fully grown, is yet prominently marked. The cirrus segments are longer than those of *C. aculeata.* The other specimen has the arms only 55 mm. long. The dorsal ornamentation is only just beginning to appear, but is already of the type characteristic of the fully grown. The peripheral cirri are XIV, 19–20, 21 mm. long. The centrodorsal is of the characteristic shape.

The specimen from *Albatross* station 5349 is large and resembles the type.

Of the specimens from *Siboga* station 297 one, with the arms about 170 mm. long, very closely resembles the type; it is very slightly smaller and more slender, and the median ornamentation of the arms is slightly less pronounced, though of exactly the same character.

Another specimen is somewhat smaller than the preceding with the dorsal ornamentation somewhat less marked; the cirrus sockets are arranged in a single regular column in the middle of each radial area, 3, in one case 4, to a column; the surface of the centrodorsal between the columns is bare and flat.

A very small specimen has the arms 75 mm. long; the centrodorsal, which exactly resembles that in the preceding except that the interradial areas are slightly convex, appears unnaturally large. The radials are as large as the IBr_1; deep subradial clefts are present. The longest cirrus is 18 mm. long with 17 segments; the short apical cirri are 7 mm. long with 11 segments, of which the third corresponds to the fourth in the larger cirri. The longer segments are proportionately slightly longer than in the larger cirri, and there are only four short distal segments instead of eight or nine. The division series and arm bases are obscurely rounded carinate, resembling those of *C. aculeata* as figured by Carpenter.

Another very small specimen has the arms 55 mm. long, and the longest cirri 12 mm. long with 13 segments.

All the specimens from this station have the median brachial ornamentation very slightly less accentuated than in the type. As in the type, the centrodorsal is sharply conical, and the cirrus sockets are arranged in two closely crowded converging columns which are confined to the midradial region.

Localities.—*Albatross* station 5348; Palawan Passage, Philippines; Point Tabonan bearing S. 89° E., 33.5 miles distant (lat. 10°57′45″ N., long. 118°38′15″ E.); 685 meters; bottom temperature 13.55° C.; coral and sand; December 27, 1908 [A. H. Clark, 1911, 1912, 1916, 1918] (3, U.S.N.M., 27505 [type], 35660).

Albatross station 5349; Palawan Passage; Point Tabonan bearing N. 85° E., 45.2 miles distant (lat. 10°54′00″ N., long. 118°26′20″ E.); 1,334 meters; bottom temperature 4.77° C.; coral and sand; December 27, 1908 [A. H. Clark, 1911, 1912, 1916, 1918] (1, U.S.N.M., 35661).

Siboga station 297; East Timor Sea (lat. 10°39′ S., long. 123°40′ E.); 520 meters; soft gray mud with brown upper layer; January 27, 1900 [A. H. Clark, 1918] (6, U.S.N.M., E. 464; Amsterdam Mus.).

Geographical range.—From the southern Philippines southward to the East Timor Sea.

Bathymetrical range.—From 520 to 1,334 meters.

Thermal range.—From 4.77° to 13.55° C.

History.—This species was originally described in 1911 under the name of *Chlorometra robusta* from a large specimen from *Albatross* station 5348; notes were given on two others from the same station, and another large specimen from station 5349. *Chlorometra robusta* was listed, with the synonymy and locality, in my memoir on the crinoids of the Indian Ocean published in 1912. In 1916 *Chlorometra robusta* was selected as the type species of the new genus *Chondrometra*. In my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 six specimens were recorded from station 297; notes on these were given, and the centrodorsal of one of them was figured.

CHONDROMETRA ACULEATA (P. H. Carpenter)

Antedon aculeata P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 128 (description; *Challenger* station 214), pl. 23, fig. 3.—Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (systematic and bathymetrical relationships).—A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 142 (compared with *A.* [*Chlorometra*] *garrettinana*).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (identity).

Charitometra aculeata A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed).—Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (type of a nonoceanic group of the genus).

Chlorometra aculeata A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 22 (listed); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 558 (compared with *Ch. robusta*); Crinoids of the Indian Ocean, 1912, p. 33 (identity), p. 225 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 49 (published reference to specimen in the B. M.; *Challenger* station 214; character of the brachial carination).

Chondrometra aculeata A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 608 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 188 (in key; range).

Diagnostic features.—The centrodorsal is conical, much broader at the base than high, with the cirrus sockets arranged in 5 more or less regular midradial columns; the arms are 75 mm. long; and the cirri are 27 mm. long with about 18 segments.

Description.—The centrodorsal is subconical, rather small, with the cirrus sockets in 5 somewhat irregular midradial columns of 2, 3, or occasionally 4, all the columns converging at the apex of the centrodorsal.

The cirri are about XV, about 18; most of the segments are longer than broad. In the figure the first segment is very short, the second is rather more than twice as broad as long, the third is about twice as broad as long, and those following are from one-third to one-half again as long as broad. The penultimate segments bear an inconspicuous opposing spine. The figure shows a cirrus almost straight and tapering slightly in the distal half; the terminal claw is shown as only slightly curved.

The radials are short and bandlike, marked by occasional grooves and projections. The IBr_1 are longer, with flattened lateral borders, but sharply convex in the center where they rise to meet the posterior projection of the axillaries. The IBr_2 (axillaries) and the first four brachials have a high center and depressed margin like the IBr_1, with sharp lateral edges and flattened sides.

The 10 arms are probably about 75 mm. long. The proximal brachials are rather short with a sharp mediodorsal line, those following wedge-shaped and more distinctly carinate so as to overlap. The figure shows the brachials rather sharply carinate with the dorsal profile rising from the proximal to the distal end so that the profile of the arm as a whole is strongly serrate.

Syzygies occur between brachials 3+4, again between about brachials 15+16, and distally at intervals of from 6 to 9 oblique muscular articulations.

P_1 is rather larger than its successors, the basal segments of which are short and laterally compressed with a sharp dorsal edge. In the pinnules of the eleventh and following brachials the third segment and its successors are not expanded but gradually become longer than broad, and in the terminal third much elongated. Carpenter said that insofar as he was able to make out without mutilating the specimen the proximal pinnules have somewhat the trihedral form with flattened outer sides that is characteristic of *Charitometra basicurva*. Their next successors are altogether different, however, the third and following segments becoming relatively longer until they attain the usual elongated shape which is characteristic of the middle and distal pinnules. But they acquire this shape at about the eleventh or thirteenth brachial so that they differ from the broad and expanded pinnules in the corresponding part of the arms of *Glyptometra tuberosa*.

The disk is concealed. The covering plates of the pinnule ambulacra are supported on a limestone band which is not distinctly differentiated. The gonads are not protected by plates. The sacculi are variable, being moderately abundant on some pinnules and rare on others.

The color in alcohol is light brownish white.

Note.—An examination of the type specimen in the British Museum showed that this is a small species with a narrow carination. The specimen appears to be a young individual, and may prove to be a young example of *C. robusta.*

Locality.—*Challenger* station 214; off the Meangis Islands (lat. 4°33′ N., long. 127°06′ E.); 914 meters; bottom temperature 5.44° C.; blue mud; February 10, 1875 [P. H. Carpenter, 1888; Hartlaub, 1895; A. H. Clark, 1907, 1908, 1909, 1911, 1912, 1913, 1916, 1918; Hamann, 1907] (1, B. M.).

History.—*Antedon aculeata* was described and figured by Dr. P. H. Carpenter in his report on the comatulids of the *Challenger* expedition published in 1888. Its systematic and bathymetrical relationships were discussed by Dr. Clemens Hartlaub in 1895, and in 1907 I compared it with a new species, *Antedon* (*Chlorometra*) *garrettiana.*

In my first revision of the old genus *Antedon* published in 1907 *aculeata* was referred to the new genus *Charitometra,* and in 1908 *Charitometra aculeata* was mentioned as the type of a nonoceanic group within the genus. On the establishment of the new genus *Chlorometra* in 1909 *aculeata* was referred to it. In 1911 I compared *Chlorometra aculeata* with a new species, *C. robusta,* and in my memoir on the crinoids of the Indian Ocean published in 1912 *Chlorometra aculeata* was listed and the synonymy and range were given. In 1913 I published a short note on the type specimen in the British Museum. In 1916 *aculeata* was again transferred to the new genus *Chondrometra.* In my memoir on the unstalked crinoids of the *Siboga* Expedition *aculeata* was included in the key to the species of the genus *Chondrometra* and the synonymy and range were given.

CHONDROMETRA RUGOSA A. H. Clark

[See vol. 1, pt. 1, fig. 99, p. 160.]

Chlorometra rugosa F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Pap. 90–L, 1915, p. 194 (*nomen nudum;* inorganic constituents of the skeleton); Prof. Pap. 102, 1917, pp. 21 and following (same); Prof. Pap. 124, 1922, p. 17 (same).

Chondrometra rugosa A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 608 (listed; *nomen nudum*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (in key; range), p. 188 (detailed description; station 297), fig. 8, pp. 188, 189 (*Albatross* station 5656), p. 275 (listed), pp. 277, 278 (inorganic constituents of the skeleton).—Gislén, Vid. Medd. Dansk Nat. Foren. København, vol. 83, 1927, p. 33 (compared with *Perissometra aranea*).

Diagnostic features.—The centrodorsal is very large, truncated conical or more or less columnar, with the cirrus sockets arranged in 10 regular columns, each radial area with 2, more or less widely separated in the midradial line; the arms are 210 mm. long; and the cirri are short, about one-sixth of the arm length, 35 mm. long with 18–19 segments.

Description.—The centrodorsal is very large, truncated conical, almost columnar, 9 mm. broad at the base, 4.5 mm. across the slightly convex dorsal pole, and 7 mm. high interradially. The cirrus sockets are arranged in 10 regular columns, two to each radial area; the columns in each radial area are almost or quite in contact with each other, those of adjacent radial areas separated by a narrow and irregular bare area which may show a slight narrow rounded ridge in the center. There are three cirrus sockets to a column.

The cirri are XXX, 18–19, 35 mm. long, short and stout. The first segment is very short, the second is about twice as broad as long, and those following gradually increase in length so that the fifth is about as long as the median or distal diameter. The remaining segments are all about half again as long as the proximal width. The last five segments decrease rather rapidly in diameter so that the penultimate segment and the terminal claw are very small. After the first four segments the cirri become rather strongly compressed laterally; the ends of the segments are slightly swollen and prominent.

The ends of the basal rays are visible as small tubercles in the angles of the calyx.

The radials are entirely concealed. The IBr_1 are almost concealed, but their distal portion, which is more or less irregular and tubercular, is visible as a narrow band just below the axillaries.

The 10 arms are about 210 mm. long. The diameter of the animal at the level of the seventh brachial is 22 mm. The proximal brachials have the same prominent median tubercles as those of *C. robusta*, but they are pointed instead of being rounded as in that species, and they lean somewhat anteriorly so that they appear as broad stout overlapping spines. Instead of being perfectly smooth as in *C. robusta*, the distal borders of these earlier brachials are thickened and produced. These thickened and produced borders after the first six or seven brachials bear, in addition to the large broad median spine the base of which runs backward along the whole median line of the dorsal surface of the segment, one or two smaller and more pointed spines between the median spine and the lateral border which do not involve the dorsal surface of the segments.

Localities.—*Siboga* station 297; East Timor Sea (lat. 10°39′ S., long. 123°40′ E.); 520 meters; soft gray mud with brown upper layer; January 27, 1900 [F. W. Clarke and W. C. Wheeler, 1915, 1917, 1922; A. H. Clark, 1916, 1918; Gislén, 1927] (1, Amsterdam Mus.).

Albatross station 5656; Gulf of Boni, Celebes; Olang Point bearing N. 67° W., 14.5 miles distant (lat. 3°17′40″ S., long. 120°36′45″ E.); 871 meters; bottom temperature 5.11° C.; gray mud; December 19, 1909 [A. H. Clark, 1918] (1, U.S.N.M., 35702).

Geographical range.—From Celebes to the East Timor Sea.

Bathymetrical range.—From 520 to 871 meters.

Thermal range.—One record, 5.11° C.

History.—This species was first mentioned as *Chlorometra rugosa* (*nomen nudum*) by Prof. Frank Wigglesworth Clarke and Dr. W. C. Wheeler in an analysis of the inorganic constituents of the skeleton published in 1915 and republished in 1917 and 1922. The fragments analyzed came from the type specimen dredged at *Siboga* station 297. On the establishment of the genus *Chondrometra* in 1916 *Chondrometra rugosa* (*nomen nudum*) was listed among the constituent species. *Chondrometra rugosa* was described and figured in my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 on the basis of a specimen from station 297, and at the same time another specimen was recorded from *Albatross* station 5656; Clarke and

Wheeler's analysis of the skeleton was given in an appendix. In 1927 Prof. Torsten Gislén compared *Chondrometra rugosa* with his new species *Perissometra aranea*.

Genus MONACHOMETRA A. H. Clark

Antedon (part) von Graff, *Challenger* Reports, Zoology, vol. 20, pt. 61, 1887, pp. 8, 12, and following authors.

Charitometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361.

Pachylometra (part) A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 21.

Perissometra (part) A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607.

Monachometra A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607 (diagnosis; genotype *Pachylometra fragilis* A. H. Clark, 1912; range; included species); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 173 (in key; range), p. 185.—Gislén, Vid. Medd. Dansk Nat. Foren. København, vol. 83, 1927, pp. 2, 38; Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, pp. 8, 9; Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Monachomera Preston, Zool. Record for 1924, 1925, p. Echin. 27.

Diagnosis.—A genus of Charitometridae in which the genital pinnules taper evenly from the usually more or less broadened earlier segments to a delicate and slender tip, the portion beyond the gonads being much longer than the gonads themselves; the outer portion of the arms is rounded dorsally, sometimes with a slightly raised broad median line; the oral pinnules are of about the length of the pinnules following, often slightly shorter; the ossicles of the division series rise to a prominent, narrow, high, smooth, and more or less pointed synarthrial tubercle the profile of which forms a distinct and often acute angle; the IIBr series are 2; there are 10–21 arms 90–250 mm. long; the cirri are arranged in 10 or 15 columns on the centrodorsal; and the cirri have 17–31 segments with the opposing spine often bifurcate.

Geographical range.—From the northern Philippines southward to the Kei Islands.

Bathymetrical range.—From 104 to 704 meters.

Thermal range.—Two records, 7.2° and 15.0° C.

Remarks.—The genus *Monachometra* as here understood includes, in addition to *M. fragilis* the type species, *M. patula*, *M. robusta*, and *M. flexilis*, all of which were previously placed in the genus *Perissometra*. Gislén in 1928 suggested that *patula* should be referred to *Monachometra*, and at the same time definitely assigned *robusta* to that genus.

The species of *Monachometra* are most readily distinguished from those of *Glyptometra* by the smoothness of the division series and arm bases combined with the rather prominent synarthrial tubercles, and the occurrence of IIBr 2 series only.

Monachometra does not differ essentially from the earlier genus *Chlorometra* (=*Diodontometra* Gislén) with which possibly it should be combined.

History.—*Monachometra* was established in 1916 with the genotype and only species *Pachylometra fragilis* which had been described in 1912. Gislén discussed the genus in 1927 and described a second species, *M. mortenseni* (=*Parametra orion*). In 1928 he discussed the genus at greater length tentatively adding Carpenter's *Antedon patula* and definitely adding Carpenter's *Antedon robusta*.

KEY TO THE SPECIES IN THE GENUS MONACHOMETRA

a^1. Brachials in the proximal portion of the arms with prominently raised distal edges; 10–21 arms 90–190 mm. long (Philippines to the Kei Islands and the Sahul Bank; 104–385 meters).
patula (p. 209)

a^2. Brachials in the proximal portion of the arms with unmodified distal edges.

b^1. Centrodorsal columnar or slightly tapering, with the cirrus sockets arranged in 10 columns, the midradial lines bare; cirri with 20–25 segments; 10–13 arms about 175 mm. long (Kei Islands; 256 meters)--**flexilis** (p. 213)

b^2. Centrodorsal low, flattened hemispherical or discoidal, with the cirrus sockets arranged in 15 crowded and slightly irregular columns.

c^1. Large, with 12–17 arms up to 250 mm. long; cirri with up to 31 segments, up to 70 mm. long (northern Celebes southward to the Kei Islands, the Sahul Bank, and Timor; 256–520 meters)--**robusta** (p. 216)

c^2. Smaller, with 19 arms 145 mm. long; cirri with 17–20 segments (northern Philippines to the Halmahera Sea; 118–704 meters)--------------------------------------**fragilis** (p. 219)

MONACHOMETRA PATULA (P. H. Carpenter)

PLATE 20, FIGURE 61

Antedon patula P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 219 (description; *Challenger* station 192), pl 43.—BELL, Journ. Linn. Soc. (Zool.), vol. 24, 1894, p. 341 (in part; Sahul Bank), pl. 24, figs. 2–6.—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 34 (identity).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 309 (in *Spinifera* group; history).—A. H. CLARK, Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 85 (of Bell= *P. patula*+*robusta*).

Charitometra patula A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed).

Pachylometra patula A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 21 (listed); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 557 (*Albatross* station 5356); Mem. Australian Mus., vol. 4, 1911, p. 795 (synonymy; Sahul Bank); Crinoids of the Indian Ocean, 1912, p. 34 (identity), p. 219 (synonymy; localities); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 48 (published references to specimens in the B. M.; *Challenger* station 192; Sahul Bank).—F. W. CLARKE and WHEELER, U. S. Geol. Surv. Prof. Pap. 90–D, 1914, pp. 33 and following (inorganic constituents of the skeleton); Prof. Pap. 102, 1917, pp. 20 and following (*Albatross* station 5036; same); Prof. Pap. 124, 1922, p. 17 (same).

Perissometra patula A. H. CLARK, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 176 (in key; range), p. 179 (references).—GISLÉN, Vid. Medd. Dansk Nat. Foren. København, vol. 83, 1927, p. 35; Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8, No. 36 (2 widely different forms under this name; notes); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Diagnostic features.—The brachials in the proximal portion of the arms have prominently raised distal edges; the centrodorsal is subconical, flattened at the apex, with the cirrus sockets arranged in 10 columns; the 10–21 arms are 90–190 mm. long; and the cirri have about 20 segments.

Description.—The centrodorsal is subconical and flattened at the apex, with short and broad interradial processes at the ventral angles. The cirrus sockets are arranged in 10 columns, 3 or 4 in each column, the columns in each radial area being in close apposition interradially but separated in the midradial line.

The cirri are about XXX, 20; the segments are stout and smooth, mostly longer than broad, the longest from slightly longer than broad to half again as long as broad; they are somewhat compressed laterally and have a sharp dorsal keel.

The radials are not visible. The IBr_1 are short, closely appressed laterally, and almost V-shaped in lateral view. The IBr_2 (axillaries) are widely rhombic with a large rounded posterior projection which is more or less tubercular in character. The IIBr series are 2. The IBr series, IIBr series, and first three or four brachials have sharp lateral edges and flattened sides. The surface of the elements of the IIBr series and of the lowest brachials rises to a more or less distinct tubercular projection.

The 20 arms are about 175 mm. long and are composed of about 160 brachials, of which the fourth and following are short and nearly oblong, their surface rising considerably from the proximal to the distal ends, which stand up rather prominently. Beyond the fifteenth the brachials are more triangular, with a median ridge, and overlap slightly.

Syzygies occur between brachials 3+4, again from between brachials 19+20 to between brachials 21+22, and distally at intervals of from 5 to 9, usually 7 or 8, oblique muscular articulations.

P_1 is about 8 mm. long and consists of about 25 short segments the lowest of which are broad and rather sharply flattened. P_2 is a trifle longer and stouter with a smaller number of larger segments. In the next following pinnules the segments gradually increase in size and become more carinate, the third–fifth being the broadest; but they do not become longer than broad until some way out on the arm. The genital pinnules have a covering of small plates with the sacculi scattered upon them, and the ambulacra of the later pinnules have well differentiated side plates with intervening sacculi.

The disk is 10 mm. in diameter and is thickly plated, as are the arms, both along the ambulacra and in the intermuscular spaces.

The color in alcohol is whitish brown, the disk darker.

Notes.—Professor Gislén noted that the *Challenger* specimens in the British Museum represent two widely different forms.

In the first form the centrodorsal is discoidal; the cirri are stout and are arranged in 12 columns, and have a dorsal spine and keel and a simple opposing spine. He remarked that one specimen with only 10 arms is, as is often the case, the larger one. This form, he said, should be referred to *Monachometra.*

In the second form the centrodorsal is sharply conical; the cirrus sockets are striated as in some fossil comatulids. The cirri are in 10 columns without dorsal spines and with a double opposing spine. The brachials are collar shaped. He said that the arms are very similar to those of *Diodontometra,* but the arrangement of the cirri is different. He noted that this seems to be the type described and figured by Carpenter.

Of the three specimens from *Albatross* station 5356 one has 14 arms about 170 mm. long and the cirri XXII, 19–22, about 30 mm. long, with a single large and prominent opposing spine; another has 16 arms about 170 mm. long and the cirri XX, 18–20, 30–33 mm. long with the opposing spine large and prominent and usually forked at the tip; and the third has 20 arms and the cirri XXV, 17–22, 30–37 mm. long with the opposing spine single.

One of the two specimens from the Danish Expedition to the Kei Islands station 3 has 20 arms 115 mm. long, with ten IIBr 2 series; the longest cirri are 32 mm. long with 19–20 segments. The other specimen from station 3 has 20 arms 160 mm. long.

The three specimens from the Danish Expedition to the Kei Islands station 3 may be described as follows.

The centrodorsal is stout, conical, not so high as broad at the base, with the cirrus sockets arranged in 10 crowded columns of 2 or 3 each.

The cirri are XXV, 18–20, long and stout, 35 mm. long. The first segment is very short, the third is half again as broad as long, the fourth–sixth or –seventh are half again as long as broad, and those following are slightly shorter, but the last two are slightly longer again. The dorsal surface of the segments in the outer half of the cirri is faintly subcarinate. The penultimate segment is nearly or quite half again as long as broad, slightly narrower than the segment preceding, with the dorsal and ventral profiles parallel. The opposing spine is terminal, directed obliquely forward, and forked. The terminal claw is about as long as the penultimate segment, rather stout basally and moderately curved.

The ends of the basal rays are visible as large rhombic tubercles in the interradial angles, which almost or quite separate the radials. The radials are concealed except for the distal border, which is much swollen and forms a chevron-shaped band just above the margin of the centrodorsal, which has a slight tubercular swelling in the middle, and sometimes another on either side of this. The IBr_1 are extremely short, forming a swollen chevron-shaped band similar to that formed by the radials, but somewhat wider. The center of this band is swollen into a broad low tubercle, and the lateral ends are abruptly produced and sometimes swollen, meeting those of the adjacent IBr_1. The lateral distal angles are rounded. The IBr_2 (axillaries) are rhombic, twice as broad as long. The proximal half is raised into a broad well-rounded tubercle. Below the lateral angles there is a flangelike proximal extension which meets the distal border of the IBr_1. As a result of this, the axillaries are seen to have straight lateral borders, meeting those of the neighboring axillaries, which are about as long as the sides of the IBr_1. The IIBr series are 2.

The 10–13 arms are 190 mm. long. The first brachials are half again as long exteriorly as interiorly, four times as broad as the median length; the proximal and distal edges are parallel from the inner border as far as the median line, where the distal edge runs at an angle to the proximal edge to the outer distal angle. The inner distal angle is somewhat produced and broadly rounded, slightly overlapping the adjacent portion of the second brachial. The second brachials are about twice as large as the first, almost twice as long exteriorly as interiorly. The proximal border is in the form of an obtuse angle with the apex in the median line. The first syzygial pair (composed of brachials 3+4) is oblong, three times as broad as long; the dorsal surface of both the hypozygal and epizygal is swollen, so that the syzygial line lies in a groove between them. The next 10 brachials are oblong or slightly wedge-shaped, about four times as broad as the median length. The middle of the dorsal surface is raised into a high ridge distal to which the surface slopes evenly to the distal border, while proximally it drops almost or quite perpendicularly to the longitudinal axis of the arm, so that proximally the ridge is bordered by a narrow portion of the surface of the brachial which is parallel with the longitudinal axis of the arm. Beyond the tenth brachial the portion of the surface distal to the ridge becomes hollowed so that the ridge becomes narrower and more conspicuous. On the earlier triangular brachials the ridge is strongly and regularly curved, passing from the distal end of the shorter side inward and downward through the proximal third of the median line and upward and outward to near the distal end of the longer side. Soon the ridge becomes angular, the apex of the angle being in the middle of the median line. It then moves distally and soon comes to coincide with the distal border of the brachials, where it disappears. On the triangular brachials the midline proximal to the angle of the ridge is raised into a rounded keel. As the ridge moves distally and disappears this median keel becomes narrower and more prominent, though always very low and rounded, and persists to the arm tips.

On arms arising from a IIBr axillary and not quite of full size the first six brachials are wholly without ornamentation, but the midline is rather narrowly rounded, or faintly subcarinate. On the succeeding brachials the distal border is slightly thickened, and the median carination becomes more distinct. On the earlier triangular brachials the thickening of the distal edge disappears, leaving only the low median carination which persists to the arm tips.

P_1 is 11 mm. long with 29 segments and tapers evenly from the base to the slender and flagellate tip. The first segment is twice as broad as long with the distal border strongly concave. The second segment is narrower, about as long as broad at the base, with diverging sides so that its distal angles overlap the base of the succeeding segment. The following segments are of decreasing size, with less and less overlapping of the distal corners, those after the fifth being very small and somewhat broader than long. P_2 is 11.5 mm. long with 22 segments, similar to P_1 but less slender with larger segments, all of which are broader than long. P_3 is 14 mm. long with 21 segments, most of which are about as long as broad; it is considerably stouter than P_2. P_4 is 14 mm. long with 17–18 segments of which the third to eighth are slightly broadened and the terminal 6 or 7 are about half again as long as broad. The following pinnules are similar. The broadening is greatest on the fifth and sixth segments, later on the fourth and fifth, from which point the pinnule tapers very gradually to the slender tip.

The specimen from the Danish Expedition to the Kei Islands station 59 is small with 21 arms 90 mm. long. One IIIBr 2 series is present, externally developed. The borders of the elements of the IBr series bear a few widely scattered beadlike tubercles.

The specimen from the Sahul Bank is young.

Localities.—*Albatross* station 5356; North Balabac Strait, Philippines; Balabac Light bearing S. 64° W., 15.5 miles distant (lat. 8°06′40″ N., long. 117°18′45″ E.); 104 meters; sand and shells; January 5, 1908 [A. H. Clark, 1911; F. W. Clarke and W. C. Wheeler, 1914, 1917, 1922 (given by error as station 5036)] (3, U.S.N.M., 35704).

Challenger station 192; near the Kei Islands (lat. 5°49′15″ S., long. 132°14′15″ E.); 256 meters; blue mud; September 26, 1874 [P. H. Carpenter, 1888; Hamann, 1907; A. H. Clark, 1907, 1909, 1912, 1913, 1916, 1918; Hartlaub, 1912; Gislén, 1927, 1928, 1934] (2, B.M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 3; 245 meters; sand; March 31, 1922 (2, C.M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 8; about 300 meters; mud; May 5, 1922 (3, U.S.N.M., E. 3190; C.M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 46; 250 meters; May 2, 1922 (1, C.M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 59; 385 meters; May 12, 1922 (1, C.M.).

Sahul Bank [Bell, 1894; A. H. Clark, 1911, 1912, 1913, 1916, 1918] (1, B.M.).

Geographical range.—From the Philippines southward to the Kei Islands and the Sahul Bank.

Bathymetrical range.—From 104 to 385 meters; the average of six records is 257 meters.

History.—*Antedon patula* was described by Dr. P. H. Carpenter in his report on the comatulids of the *Challenger* expedition published in 1888, his material consisting of two specimens. In 1894 Prof. F. Jeffrey Bell recorded four specimens from the Sahul Bank, figuring portions of the arms of three of them and the distal portion of the cirri of two. He wrote that he was at first inclined to consider the four specimens which he included under the name *Antedon patula* as representatives of a new species, but Carpenter's species is founded on two specimens of much the same size, and smaller and younger examples such as he had before him might well have a smaller number of cirri and a less marked development of the ridge on the more distal of the brachials. He noted that *Antedon flexilis*, *A. patula*, and *A. robusta* were all taken at the same station by the *Challenger* and remarked it is very likely that an increase in our series may show that there are not so many well-marked species as has been supposed.

In my first revision of the old genus *Antedon* published in 1907 *patula* was transferred to the new genus *Charitometra*, and in the same year it was listed as *Antedon patula* by Hamann. Upon the establishment of the genus *Pachylometra* in 1909 I transferred it to that genus. In 1911 I recorded and gave notes on three specimens of *Pachylometra patula* from *Albatross* station 5356, and in my memoir on the Recent crinoids of Australia I included the record from the Sahul Bank. In my memoir on the crinoids of the Indian Ocean published in 1912 I listed *Pachylometra patula*, giving the synonymy and locality records, and in the same year Dr. Clemens Hartlaub mentioned *Antedon patula* in his discussion of the *Spinifera*-group of the genus *Antedon*. In 1913 I noted that at the British Museum I had examined two specimens of *Pachylometra patula* from *Challenger* station 192, and one young specimen from the Sahul Bank recorded as *Antedon patula* by Bell. A second specimen from the Sahul Bank I identified as *Pachylometra robusta*.

In 1914 Prof. Frank Wigglesworth Clarke and Dr. W. C. Wheeler published an analysis of the inorganic constituents of the skeleton of *Pachylometra patula;* they gave the locality of their material as *Albatross* station 5036, which is an error for station 5356.

In 1916 I transferred *patula* to the new genus *Perissometra*, and in my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 *patula* was included in the key to the species of *Perissometra* and the synonymy and range were given.

In his report on the crinoids collected by Dr. Th. Mortensen in Japan published in 1927 Prof. Torsten Gislén discussed the genera *Glyptometra* and *Perissometra*, pointing out the unsatisfactory nature of the supposed differences between them and suggesting that *patula* should be transferred to *Glyptometra*. In 1928 he wrote that the two specimens from *Challenger* station 192, which he had examined in the British Museum, represent two widely different forms, one of which ought to be referred to *Monachometra*. In 1934 he classed the arm division of *Perissometra patula* with the *Asterometra* type.

MONACHOMETRA FLEXILIS (P. H. Carpenter)

[See vol. 1, pt. 2, pl. 44, figs. 1288–1290, 1292.]

Antedon flexilis von Graff, *Challenger* Reports, Zoology, vol. 20, pt. 61, 1887, pp. 8, 12 (*Challenger* station 192; myzostomes; *nomen nudum*).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 128, 217 (description; *Challenger* station 192), pl. 42.—Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 130 (systematic and bathymetrical relationships), p. 134 (size compared with that of *A.* [*Thalassometra*] *agassizii* [erroneously given as 55 cm. instead of 35 cm.]), p. 135 (compared with *A.* [*Thalassometra*] *agassizii*).—Minckert, Arch. Naturg., Jahrg. 71, 1905, vol. 1, Heft 1, pp. 211 and following (syzygies; regeneration).—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, pp. 1578, 1581 (listed).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 309 (in *Spinifera* group; history).

Charitometra flexilis A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed).

Pachylometra flexilis A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 21 (listed); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 557 (correction of the dimensions given in the original description); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 77 (comparison with *P. crassa*); Crinoids of the Indian Ocean, 1912, pp. 33, 34 (identity), p. 219 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 48 (published references to specimens in the B. M.; *Challenger* station 192).

Perissometra flexilis A. H. CLARK, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 178 (in key; range), p. 182 (references).—GISLÉN, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8, No. 37 (notes).

Diagnostic features.—The brachials in the proximal portion of the arms have unmodified distal edges; the centrodorsal is columnar or slightly tapering with the cirrus sockets arranged in 10 columns, the midradial lines bare; the 10–13 arms are about 175 mm. long; and the cirri have 20–25 segments.

Description.—The centrodorsal is columnar or slightly tapering with its ventral angles produced into marked interradial processes. The cirrus sockets are arranged in 10 columns which are in contact interradially but separated by a bare line in the midradial areas; there are 3 or 4 sockets in a column.

The cirri are XXX–XXXV, 20–25. The segments are stout but very smooth, and are mostly longer than broad. In the figure they are shown as from very slightly longer than broad to about one-third again as long as broad. The penultimate segment bears an opposing spine.

The radials are visible. The radials and the elements of the IBr series, especially the IBr_2 (axillaries) are rather sharply convex with a more or less distinct median tubercle. The IBr axillaries are subhexagonal and considerably broader than the IBr_1 which are short and bandlike and in close contact laterally. The IIBr series, when present, are 2.

The 10–13 arms are about 175 mm. long. The first two brachials or the elements of the IIBr series, when these are present, have median tubercles like those of the IBr series, but less prominent. The IBr axillary and the two following segments have sharp straight edges and flat wall-like sides. The inner side of the second and third (hypozygal) brachials are also flattened, especially when the IIBr series are absent. The lower brachials are somewhat discoidal with very rounded surfaces, and those following are shortly triangular with the edges slightly raised, but they gradually become more smooth and relatively longer.

Syzygies occur between brachials 3+4, again from between brachials 13+14 to between brachials 19+20, and distally at intervals of from 4 to 8, usually 5 or 6, oblique muscular articulations.

The first pinnules reach 13 mm. in length and are composed of about 40 short and broad segments; their outer sides are somewhat flattened against one another below. The pinnules following are of about the same length, but the segments gradually increase in size and diminish in number, still remaining much broader than long. In the pinnules of the sixteenth and of several of the following brachials the fourth and fifth segments are considerably broader than their fellows, but in the later pinnules the segments are longer than broad.

The disk is 10 mm. in diameter, not much plated except along the ambulacra. There is a strong covering of plates over the gonads, with numerous sacculi imbedded in it. The later pinnules have a well-defined ambulacral skeleton, the sacculi alternating with the side plates.

The color in alcohol is a light whitish brown with a brownish gray ventral perisome.

Notes.—Carpenter gave the expanse of the specimen he described as 55 cm., which is equivalent to an arm length of 275 mm. But his figure shows a specimen with an arm length of about 250 mm., at an enlargement of 1½ times, which, corrected, gives an arm length of 176 mm. Apparently, therefore, the expanse as given, 55 cm., is a typographical error for 35 cm.

I examined two fine specimens from Carpenter's type series at the British Museum and found this to be a large, robust, and handsome species.

After examining the same specimens Prof. Torsten Gislén wrote that the centrodorsal is a high cone. The cirri are in 10 columns, and are without dorsal spines. The opposing spine is forked or transverse. The genital pinnules have rather much expanded segments.

Locality.—*Challenger* station 192; near the Kei Islands (lat. 5°49′15″ S., long. 132°14′15″ E.); 256 meters; blue mud; September 26, 1874 [von Graff, 1887; P. H. Carpenter, 1888; Hartlaub, 1895, 1912; Minckert, 1905; A. H. Clark, 1907, 1909, 1911, 1912, 1913, 1916, 1918; Gislén, 1928] (2, B. M.).

History.—Prof. Ludwig von Graff in the *Challenger* report on the myzostomes published in 1887 mentioned *Antedon flexilis* as a host of certain species. The name, which had been given him by Dr. P. H. Carpenter, was a *nomen nudum.*

In 1888 in his memoir on the comatulids of the *Challenger* Expedition Carpenter described *Antedon flexilis* in detail and figured it. Dr. Clemens Hartlaub in 1895 discussed the systematic and bathymetrical relationships of *A. flexilis* and compared it with his new species *Antedon* (*Thalassometra*) *agassizii.* Minckert in 1905 discussed the syzygies of *Antedon flexilis,* and Hamann listed it in 1907.

In my first revision of the genus *Antedon* published in 1907 *flexilis* was transferred to the new genus *Charitometra;* it was again transferred to a new genus, *Pachylometra,* in 1909. In the same year I published a correction of the dimensions given by Carpenter in his original description, and in 1912 I compared it with a new species, *Pachylometra crassa.*

Hartlaub in 1912 mentioned *Antedon flexilis* in connection with his discussion of the *Spinifera* Group, and in my memoir on the crinoids of the Indian Ocean published in the same year I listed *Pachylometra flexilis,* giving the synonymy and locality. In 1913 I published a brief note on two of Carpenter's specimens which I had examined in the British Museum.

Upon the establishment of the new genus *Perissometra* in 1916 *flexilis* was transferred to it, and in my report on the unstalked crinoids of the *Siboga* Expedition published in 1918 *flexilis* was included in the key to the species of *Perissometra* and the synonymy and range were given.

Prof. Torsten Gislén in 1928 published a note on the two specimens he had examined in the British Museum.

MONACHOMETRA ROBUSTA (P. H. Carpenter)

Antedon robusta P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 220 (description; *Challenger* station 192), pl. 44, fig. 1.—HARTLAUB, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 134 (size compared with that of A. [*Thalassometra*] *agassizii*).—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 34 (identity).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 309 (in *Spinifera* group; history).

Antedon patula (part) BELL, Journ. Linn. Soc. (Zool.), vol. 24, 1893, p. 341 (Sahul Bank).

Charitometra robusta A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed).

Pachylometra robusta A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 21 (listed), p. 82 (compared with *P. macilenta*); Crinoids of the Indian Ocean, 1912, p. 34 (identity), p. 220 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 49 (published references to specimens in the B. M.; *Challenger* station 192; Sahul Bank).

Perissometra robusta A. H. CLARK, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, pp. 176, 178 (in key; range), p. 179 (references; notes; Sta. 297), p. 275 (listed).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Monachometra robusta GISLÉN, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 9, No. 40 (notes).

Diagnostic features.—The brachials in the proximal portion of the arms are smooth, without raised distal edges; the centrodorsal is low, thick discoidal, with the cirrus sockets arranged in 15 closely crowded and somewhat irregular columns; the 12–17 arms are up to 250 mm. long; and the cirri are up to 70 mm. in length with up to 31 segments.

Description.—The centrodorsal is a thick disk 9 mm. in diameter.

The cirri are about L, 18–31; according to the figure all the segments except the basal are usually longer than broad, although the last two or three may be about as long as broad. The longest segments are from one-third to one-half again as long as broad. There is a small opposing spine.

The radials are just visible in the angles of the calyx above the low interradial processes of the centrodorsal, which partly conceals the short IBr_1 in their median line. The IBr_2 (axillaries) are widely rhombic with an obtuse distal and sharper proximal angle, the latter rising to form a prominence (synarthrial tubercle) with the IBr_1. The IIBr series are 2, one being present on each of two postradial series.

The 12 arms are nearly 250 mm. long and are composed of more than 200 brachials. The first two brachials (or the elements of the IIBr series) bear a synarthrial tubercle like the IBr series, and have much flattened outer sides like the axillaries. The inner sides of the second brachials and both sides of the first syzygial pair are also sometimes flattened. The first few brachials are oblong, the later more triangular.

Syzygies occur between brachials 3+4, the next not until after brachials 21+22; the distal intersyzygial interval is long, from 10 to 26 oblique muscular articulations.

P_1 is about 12 mm. long and is composed of about 20 segments the lowest of which are much larger than their successors and are of almost prismatic shape, being flattened against the corresponding segments of the adjacent pinnules. P_a is similar but slightly smaller, and its successors are of about the same length, but have broader and flatter segments. The later pinnules gradually become elongated, but none of the segments are conspicuously wider than the rest. In the styliform middle and outer pinnules the first segment is flattened and expanded, with a curved distal edge.

The disk is 12 mm. in diameter, thickly plated, as are also the arms, both along the ambulacral grooves and in the interarticular regions. The genital pinnules are protected by irregular plates, and the ambulacra of the later pinnules have well-defined side plates with alternating sacculi, which are also fairly abundant on the genital pinnules.

In alcohol the perisome is dark blackish brown, the skeleton whiter.

Notes.—Prof. Torsten Gislén examined Carpenter's original specimen of this species at the British Museum in 1925, and published the following notes upon it. The centrodorsal is discoidal, 11 mm. in diameter; it has a smaller radial and larger interradial star dorsally, just as in certain Jurassic and Cretaceous comatulids. The cirrus sockets are striated, with small lateral tubercles. The cirri are about XXXV, in 15–20 slightly irregular columns. The arms are about 250 mm. long with a weak synarthrial carination. After examining the specimen in 1910 I wrote that this is a magnificent species remarkable for its stoutness, and that it is well figured in the *Challenger* report.

The specimen from Menado Bay, Celebes, is small with 17 arms; seven IIBr 2 series are present.

In one of the specimens from *Siboga* station 297 the centrodorsal is large and thick, truncated conical, 8 mm. broad at the base and 3.6 mm. across the stellate dorsal pole, and 6 mm. high; on the proximal edge of the centrodorsal there are rounded interradial ridges which are produced distally in a sharp angle between the proximal portion of the proximal cirrus sockets, which meet below them; proximally these fork, becoming prominent rather high tubercular processes on either side of the end of the basal ray, which they much resemble; the surface of the stellate dorsal pole is slightly concave in the center, with more or less marked radial and interradial grooves; the ends of the rays of the star are not interradial but are somewhat twisted clockwise so that they come under the left column of cirrus sockets in each radial area. The cirrus sockets are arranged in 10 crowded columns of two each, with one in the center of a radial depression and one on an interradial ridge.

The cirri are from 55 to 70 mm. long with 28–31 segments, of which the first four are short, those following gradually increasing in length to the ninth which, with the following, is about half again as long as broad. The distal ventral edge of each segment projects slightly above the base of the succeeding segment. The last six or seven segments taper very gradually so that the cirri, which throughout most of their length are about 2 mm. broad, become on the penultimate segment 1.2 mm. broad. The opposing spine is represented by a very slight terminal tubercle. The penultimate and the distal third of the antepenultimate segment (sometimes the penultimate and antepenultimate and the distal third of the segment preceding) are highly polished, in contrast to the dull surface of the preceding ossicles.

The ends of the basal rays are visible as prominent dorsoventrally elongated tubercles in the angles of the calyx.

The edge of the radials is just visible beyond the rim of the centrodorsal. The IBr_1 are very short with parallel sides, distally incised by a rounded posterior projection from the axillary, laterally curving upward and meeting over the ends of the basal rays. The distal inner angles are somewhat cut away. The median third of the dorsal surface is swollen, forming a more or less evident laterally elongated large low rounded tubercle. The proximal edge is slightly produced, especially in the lateral thirds, and the distal outer angles are slightly swollen. The IBr_2 (axillaries) are rhombic, twice as broad as long. The dorsal surface, except in the lateral thirds, is slightly raised, most prominently in the median line just within the proximal border and on the median part of the two distal faces, just within the distal borders. The lateral angles are more or less irregular, with a greater or lesser tubercular modification. The lateral edges are more or less cut away, forming, with a similar truncation of the distal angles of the IBr_1, a prominent water pore.

There are 14 arms, all in process of regeneration. The IIBr series are all 2 resembling the IBr series and with the same water pores, but with the outer edges more irregularly tuberculous. The first two brachials are similar to the elements of the division series, and have water pores interiorly and exteriorly between them. The remaining brachials have a smooth and unmodified surface as figured by Carpenter, but this is possibly due to the fact that as yet they are incompletely regenerated.

The other specimen is essentially similar. There are 16 arms, all the IIBr series being 2. All the arms except three, which are broken, are regenerating. The tubercles on the ossicles of the division series and on the first two brachials are not quite so extensive, though slightly more marked. The proximal and distal borders of these segments, except in the median line, are slightly produced and slightly scalloped, this feature increasing progressively to the margin. The lateral edges are similarly produced and slightly swollen, but nearly straight without tubercular modification. Very narrow transversely elongate slits, scarcely noticeable, mark the position of the future water pores.

I remarked that these specimens appear to represent Carpenter's *robusta*, though they are more developed than his type. The chief characteristic of the species is the very long and stout cirri.

Localities.—Menado Bay, northern Celebes (lat. 1°31′ N., long. 124°47′ E.); 457 meters; Captain Christiansen, Great Northern Telegraph Company, March 12, 1913 (1, C. M.).

Challenger station 192; near the Kei Islands (lat. 5°49′15″ S., long. 132°14′15″ E.); 256 meters; blue mud; September 26, 1874 [P. H. Carpenter, 1888; Hartlaub, 1895, 1912; Hamann, 1907; A. H. Clark, 1907, 1909, 1912, 1913, 1916; Gislén, 1928, 1934] (1, B. M.).

Sahul Bank [Bell, 1893; A. H. Clark, 1913, 1918].

Siboga station 297; off Timor (lat. 10°39′ S., long. 123°40′ E.); 520 meters; soft gray mud with a brown upper layer; January 27, 1900 [A. H. Clark, 1918] (2, U.S.N.M., E. 473; Amsterdam Mus.).

Geographical range.—From nothern Celebes southward to the Kei Islands, the Sahul Bank, and Timor.

Bathymetrical range.—From 256 to 520 meters.

History.—In the *Challenger* report on the comatulids published in 1888 Dr. P. H. Carpenter described and figured *Antedon robusta* on the basis of a single specimen from station 192. Prof. F. Jeffrey Bell in 1893 inadvertently included a specimen of this species in his record of *Antedon patula* from the Sahul Bank. Dr. Clemens Hartlaub in 1895 compared the size of *Antedon robusta* with that of his new species *A.* (*Thalassometra*) *agassizii*.

In 1907 I transferred *Antedon robusta* to my new genus *Charitometra*, and in the same year *A. robusta* was listed by Hamann. On the establishment of the new genus

Pachylometra in 1909 *robusta* was transferred to it, and later in the same year I compared *Pachylometra robusta* with the new species *P. macilenta*. In my memoir on the crinoids of the Indian Ocean published in 1912 *Pachylometra robusta* was listed and the synonymy and original locality were given. In my notes on the crinoids of the British Museum published in 1913 I recorded a specimen from the Sahul Bank that had been included under *Antedon patula* by Prof. F. Jeffrey Bell in his account of the crinoids of that area. On the creation of the genus *Perissometra* in 1916 I transferred *robusta* to it.

After an examination of Carpenter's type specimen in the British Museum Prof. Torsten Gislén gave notes on it and remarked that this species, considered by me to be a *Perissometra*, should be referred to *Monachometra*.

MONACHOMETRA FRAGILIS (A. H. Clark)

Plate 20, Figures 62, 63

[See also vol. 1, pt. 2, figs. 824–830, p. 399.]

Pachylometra fragilis A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 79 (description; *Siboga* station 166).

Monachometra fragilis A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 185 (detailed description; station 166; also *Albatross* station 5110), p. 273 (listed), pl. 24, figs. 68, 69.—[Gislén, Vid. Medd. Dansk. Nat. Foren. København, vol. 83, 1927, p. 38 (comparisons); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 21.]

[*Monachometra* cf. *fragilis* Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, pp. 44, 51, fig. 14, p. 48 (base of a post-radial series).]

Diagnostic features.—The brachials in the proximal portion of the arms have unmodified distal edges; the centrodorsal is low, flattened hemispherical, with the cirrus sockets arranged in 15 closely crowded and somewhat irregular columns; the 19 arms are 145 mm. long; and the cirri have 17–20 segments. The synarthries are unusually brittle.

Description.—The centrodorsal is low, flattened hemispherical, 7 mm. in diameter at the base and 3 mm. high; in general the centrodorsal resembles that of the species of *Crinometra*. The cirri are closely crowded and are arranged approximately in 2 or 3 irregular rows and 15 columns, 3 in each radial area; the sockets in the proximal row reach the rim of the centrodorsal.

The cirri are about XXX, 17–18, from 30 to 35 mm. long and are moderately slender. The first four segments are short, the fifth is half again as long as broad, the sixth to eighth are twice as long as broad, and those following gradually decrease in length so that the distal are about as long as broad, the terminal increasing again so that the antepenultimate and penultimate are about twice as long as broad. The longer proximal segments have slightly prominent ends, while the shorter distal have the dorsal distal margin slightly swollen.

The ends of the basal rays are large and prominent, forming rhombic areas in the angles of the calyx. Deep, though very narrow, subradial clefts are present.

The radials are very short, strongly curved, with a low, broad, and obscure median tubercle. The IBr_1 are exteriorly very short, bandlike, with an obscure low median tubercle. The articular face is produced toward the center of the calyx so that their sharply flattened lateral borders almost meet, being separated only by a narrowly

V-shaped cleft running to the edge of the inner end of the synarthrial joint face. Though the dorsal surface of the ossicle is well rounded, the distance from the central canal to the median part of the dorsal edge is not so great as the distance from the central canal to the inner angle. Counting the entire median length of the joint face, the broadest portion is found to be scarcely more than one-third the distance from the dorsal edge to the inner angle. The ossicle is laterally sharply flattened from its widest point inward. The IBr_2 (axillaries) are low, rhombic, with the lateral angles truncated so that the lateral angles are about as long as the lateral borders of the IBr_1. They are twice as broad as long. There is an obscure well-rounded carination. The distal angle is produced, but broad. The dorsal surface is rather strongly convex. The lower portions of the axillaries are strongly produced inward so that, as in the case of the IBr_1, the inner sides are reduced almost to apices which almost meet the similar inner ends of the other axillaries. From this central point the inner face of the axillaries, together with the division series, forms the platform upon which the visceral mass rests. The sides of the inner half of the axillaries are sharply flattened. The IIBr series are 2, similar to the IBr series but rapidly decreasing in dorsoventral width. They are sharply flattened laterally for somewhat more than their inner half.

The 19 arms are 145 mm. long. The first two brachials are flattened laterally for their entire inner side, and the first syzygial pair (brachials 3+4) is flattened on the inner portion of the inner side.

P_1 is slender and evenly tapering, from 9 to 10 mm. long, composed of 26 to 31 segments, all of which are much broader than long. P_2 is similar but very slightly stouter, of the same length or very slightly longer, with 25 segments, of which the outermost are about as long as broad. P_3 is 11 mm. long with 22 segments and in general resembles P_2, but the segments in the distal half are about as long as broad. P_4 is 11 mm. long with 20 segments which become as long as broad on the fifth or sixth and slightly longer than broad terminally. P_5 is 9 mm. long with 15 segments, most of which are about as long as broad. P_8 is 8 mm. long with 14 segments. P_9 is 7 mm. long with 13 segments. The distal pinnules are slender, 10 mm. long with 20 segments. On the genital pinnules the third–seventh segments are very slightly, almost imperceptibly, broadened.

The color in alcohol is brownish white, the centrodorsal and division series brownish gray.

Notes.—The specimen from *Albatross* station 5110 is smaller than the type specimen just described, though similar to it. It also has 19 arms. The fourth to tenth segments of the genital pinnules are somewhat expanded, more so than in the type specimen.

The specimen from the South China Sea is much broken. The longest cirri are 42 mm. long with 19–20 segments.

Localities.—*Siboga* station 166; Halmahera Sea (lat. 2°28′30″ S., long. 131°03′18″ E.); 118 meters; hard coarse sand; August 22, 1899 [A. H. Clark, 1912, 1916, 1918; Gislén, 1924, 1927, 1934] (1, Amsterdam Mus.).

Albatross station 5110; China Sea, off southern Luzon, Philippines; Corregidor Light bearing N. 20° E., 25 miles distant (lat. 13°59′20″ N., long. 120°25′45″ E.); 247 meters; bottom temperature 15.0° C.; dark gray mud; January 5, 1908 [A. H. Clark, 1918] (1, U.S.N.M., 35707).

China Sea south of Pratas Reef (lat. 21°10′ N., long. 117°30′ E.); 704 meters; bottom temperature 7.2° C.; May 22, 1911; Captain Suensson (1, C.M.).

Geographical range.—From the Halmahera Sea to the northern part of the South China Sea in the vicinity of Pratas Reef.

Bathymetrical range.—From 118 to 704 meters.

Thermal range.—From 7.2° to 15.0° C.

History.—This species was first described under the name of *Pachylometra fragilis* in 1912 from a specimen from *Siboga* station 166. In 1916 it was made the type of the new genus *Monachometra,* and in 1918 in my memoir on the unstalked crinoids of the *Siboga* Expedition *Monachometra fragilis* was described in detail and a second specimen was recorded from *Albatross* station 5110.

In 1924 Prof. Torsten Gislén wrote that *Monachometra* cf. *fragilis* has the thirteenth brachial the first with the pinnule-bearing side longer than the other, and that the distal angle of the IBr axillary measures 145°. He figured a postradial series of his specimen showing a IBr series followed by a single arm ending with the fourteenth brachial on the left and on the right a IIBr series with the left arm carried to the fifteenth brachial. This postradial series represents not *Monachometra fragilis,* but *Parametra orion.*

In 1927 Professor Gislén wrote I had informed him that the opposing spine of *Monachometra fragilis* is double, like that of *Diodontometra bocki,* and that there is a specimen of *M. fragilis* in the Uppsala Museum which had permitted him to make comparisons with a new species that he described as *Monachometra mortenseni.* He gave no further information regarding the specimen at Uppsala, but his *Monachometra mortenseni* is in reality *Parametra orion.* In 1934 Gislén distinguished two different types of arm division which he called *Monachometra fragilis* types I and II. Both are from the specimen in the Uppsala Museum, which appears to represent *Parametra orion.*

Genus CHLOROMETRA A. H. Clark

Chlorometra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 21 (diagnosis; genotype *Antedon garrettiana* A. H. Clark, 1907); Crinoids of the Indian Ocean, 1912, p. 9 (absent from Australia), p. 11 (absent from the west coast of the Malay Peninsula and from farther west), p. 25 (range), p. 60 (in key), p. 225 (original reference; type); Die Crinoïden der Antarktis, 1915, p. 125 (certain species of this genus show the characters of *Anthometra adriani*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 174 (in key; range), p. 190.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20.

Diodontometra Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 121 (characters; only included species *D. bocki*); Zool. Bidrag Uppsala, vol. 9, 1924, p. 280; Vid. Medd. Dansk Nat. Foren., København, vol. 83, 1927, p. 38; Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 20, 21.

Diagnosis.—The genital pinnules have the third to fifth or third to sixth segments flattened and expanded with winglike borders, the portion of the pinnules beyond being abruptly narrower and shorter than the expanded portion; the centrodorsal is sharply conical, higher than broad at the base, with the cirrus sockets in 5 midradial single or partially double columns; there are 14 to 20 arms about 60 mm. long; and the opposing spine is forked.

Geographical range.—From southwestern Japan to the Bonin Islands.

Bathymetrical range.—From 165 to 210 meters.

History.—The genus *Chlorometra* was established in 1909 with the genotype *Antedon garrettiana* A. H. Clark, 1907, also including Carpenter's *Antedon aculeata*. In 1916 *Antedon aculeata* was removed to the new genus *Chondrometra*. In 1922 Prof. Torsten Gislén established the genus *Diodontometra* with the genotype *D. bocki*, which proves to be a synonym of the very poorly and inadequately described *Antedon garrettiana*.

CHLOROMETRA GARRETTIANA (A. H. Clark)

Plate 20, Figure 64

[See also vol. 1, pt. 2, fig. 228, p. 184.]

Antedon garrettiana A. H. Clark, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 142 (description; *Albatross* station 4894).

Charitometra garrettiana A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 318 (Japan).

Chlorometra garrettiana A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 22 (listed); Crinoids of the Indian Ocean, 1912, p. 225 (synonymy; locality); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 190 (references).

Diodontometra bocki Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 123 (description; Bock's station 56), figs. 79–83, p. 88, fig. 84, p. 112, pl. 2, fig. 10; Zool. Bidrag Uppsala, vol. 9, 1924, pp. 41, 42, 44, 53, 80, figs. 81, p. 81 (syzygial face), 110, p. 93 (synarthrial face), 177–179, p. 98 (pinnule articulations); Vid. Medd. Dansk Naturh. Foren., København, vol. 83, 1927, p. 2 (station 9; 162 meters), p. 38 (station 9; notes), p. 68 (listed), figs. 28–33, p. 37; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 21.

Description.—The centrodorsal is conical, 3 mm. broad at the base and 2.8 mm. high, with the dorsal pole papillose. The cirrus sockets are arranged in 10 closely crowded columns, 2 in each radial area, the pairs of columns being separated interradially by an irregular interradial ridge but crowded together radially so that here the sockets alternate with each other.

The cirri are XX, 17; only a single cirrus remains, and this is not fully developed. It is 20 mm. long. The first two segments are very short, more than twice as broad as long, the third is twice as broad as long, the fourth is slightly broader than long, and the fifth is about one-third again as long as broad; the next three are slightly longer, the length then very slowly decreasing so that the antepenultimate is about one-third again as long as broad. The penultimate is slightly longer. There is a slight taper in the distal third of the cirri and the last two segments are dorsally roundedly subcarinate. The opposing spine is terminal, small with a rounded and not glassy tip, and is directed obliquely forward. The terminal claw is nearly as long as the penultimate segment, moderately stout and evenly tapering, gently curved, and glassy only at the tip.

The ends of the basal rays project strongly as large, rather narrow, more or less rhombic tubercles in the interradial angles. They separate the proximal half of the radials and extend downward between the sockets of the upper row, when the sockets are small reaching down to those of the lower row.

The radials are rather narrow bands of uniform width with the center raised into a prominent broad rounded tubercle. The IBr_1 are short, nearly oblong, about four times as broad as long, about twice as long as the radials, with the central portion rather abruptly raised into a rounded keel. The IBr_2 (axillaries) are about three times as broad as long with the lateral borders about two-thirds as long as those of the IBr_1, in the midline about twice as long as the IBr_1; the two distal sides are concave. A rather abrupt broad rounded median keel resembling that on the IBr_1 runs their entire length. The IIBr series are 2 and resemble the IBr series.

The 11 arms are 65 mm. long. The first two brachials are similar, slightly longer exteriorly than interiorly, about four times as broad as long. They have raised rounded median keels resembling those on the division series. The first syzygial pair (composed of brachials 3+4) is about two and one-half times as broad as long and oblong; the distal edge of the hypozygal is prominent so that the syzygial pair has the appearance of two short brachials. The next five brachials are slightly wedge-shaped, about three times as broad as long. The tenth brachial is oblong. The brachials following the tenth are very obliquely wedge-shaped, somewhat longer than broad, the proportions remaining fairly uniform to the arm tips. Each brachial has a rather broad low raised median line which in the distal portion of the arm gradually becomes obsolete. The division series and first two brachials are in close lateral apposition and are sharply flattened against each other, the flattened surface rapidly decreasing in width from the IBr_1 on which it is about three times as broad as long to the second brachial on which it is only as broad as the pinnule base.

Syzygies occur between brachials 3+4, again from between brachials 11+12 to between brachials 15+16 (usually between brachials 14+15), and distally at intervals of from 6 to 11 (usually 6 or 7) muscular articulations.

P_1 is 6 mm. long, rather slender, and tapering evenly and slowly to a rather delicate tip. It is composed of 20 segments all of which are somewhat broader than long. The first segment is about twice as broad as long, broadly crescentic with the outer end rounded and the inner end truncated. The next two segments are roughly oblong, and those following have the proximal border broadly and evenly rounded and the distal border straight or slightly concave.

P_2 is 5.5 mm. long with 17 segments. It tapers more slowly than P_1 and hence appears somewhat stouter in the distal half, and the segments are more nearly oblong, on the last ten becoming about as long as broad.

P_3 is 5.5 mm. long with 13 segments resembling P_2 but somewhat stouter.

The genital pinnules are from 3 to 4 mm. long with from 9 to 12 segments. The first segment is crescentic, twice as broad as long, the second is trapezoidal, nearly as long as broad, and those following are oblong, somewhat longer than broad. The two terminal are small. In the shorter genital pinnules the third and fourth segments are markedly longer and slightly broader than those following, though they are not broader than the two basal segments; the third segment is about half again as long as broad or a little longer, the fourth is twice as long as broad, and the fifth is slightly longer than broad.

The distal pinnules are 5 mm. long with 13 or 14 segments, of which all but the two basal and the terminal are about one-third again as long as broad.

Notes.—There appears to be no doubt that *Antedon garrettiana*, very inadequately described in 1907, was based upon an immature individual of the species described and figured by Gislén in 1922 under the name of *Diodontometra bocki*, which in 1927 he recorded from Mortensen's station 9, near the type locality of *garrettiana*.

The centrodorsal of the type specimen of *garrettiana* and the arrangement of the cirrus sockets are very closely similar to the same features figured by Gislén in a specimen from

Mortensen's station 9, although in *garrettiana* the centrodorsal is not quite so long, and the interradial spaces are not quite so broad; the articular faces of the radials in *bocki* are the same as those in *garrettiana.* The cirri have the same number of segments in both, and the single cirrus that remains in the type specimen of *garrettiana* agrees with the immature cirrus shown in Gislén's photograph extending up into the arms. The form of the ossicles of the division series and of the brachials is the same in both, as is the carination, the production of the distal ends of the earlier brachials, and the smoothness of the outer portions of the arms.

Features that might seem to indicate that *bocki* is not the same as *garrettiana* are: In *garrettiana* the opposing spine is single, not forked; but the single cirrus present is of the immature type, tapering in the distal portion, and the short blunt opposing spine and terminal claw do not have the normal glassy texture; single opposing spines are not infrequent in species in which the opposing spine is normally or usually forked. In *garrettiana* the ends of the basal rays are large and prominent tubercles whereas they are not visible in *bocki*; that is simply an indication of immaturity, the basal rays being commonly very large in immature individuals of the species of Charitometridae. In *garrettiana* the radials are wholly visible as narrow bands, in *bocki* mainly concealed; this also indicates immaturity. In the type specimen of *garrettiana* there are only 11 arms, and the single IIBr series and the arms borne by it are not of full size; this is evidently the commencement of adolescent autotomy and indicates that fully mature individuals have more than 10 arms; one of Gislén's specimens of *bocki* has 14 arms. In *garrettiana* the arms are longer than in *bocki*—65 mm. as contrasted with 60 mm.; in individuals with 10 arms the arms are always longer than in those of the same species with 20 arms; the arm length of *garrettiana* is the distance from the apex of the centrodorsal to the arm tip—that is, half the diameter of the circle made by the outstretched arms; in *bocki* the arm length is presumably the length of the arms from the last axillary; measured on this basis the arm length of *garrettiana* would be the same as that of *bocki*, 60 mm. The proximal pinnules of *garrettiana* are longer than those of *bocki* with more segments; in *garrettiana* P_1 is 6 mm. long with 20 segments, in *bocki* 3.5–5 mm. long with 13–15 segments; in *garrettiana* P_2 is 5.5 mm. long with 17 segments, in *bocki* 4.5–5 mm. long with 12–14 segments; in *garrettiana* P_3 is 5.5 mm. long with 13 segments, in *bocki* 4–4.7 mm. long with 10–11 segments; these differences are slight and do not affect the relative proportions of the pinnules; they are probably due to the fact that the pinnules of *garrettiana* were measured on an arm arising from a IBr axillary whereas those of *bocki* were measured on an arm from a IIBr axillary. In the genital pinnules of *garrettiana* the third and fourth segments are often abruptly larger than those following and flattened; but they are not broader than those preceding and do not have produced lateral borders as in *bocki*; this is probably an indication of immaturity; the expansion of the genital pinnules is a very variable feature in most of the Charitometridae except for the 10-armed species. In *garrettiana* the distal pinnules are 5 mm. long with 13–14 segments, in *bocki* 4 mm. long with 11 segments; this difference may well be due to the fact that in *garrettiana* they were measured on an arm from a IBr axillary, in *bocki* on an arm from a IIBr axillary.

In balancing these correspondences and differences it appears that the former are fundamental, and taken together could scarcely be assumed to occur in two different species, while the latter are all of minor significance and are explainable on the basis of the immaturity of the type specimen of *garrettiana* in contrast with the full maturity of the described specimens of *bocki*.

Prof. Torsten Gislén described *Diodontometra bocki* as follows.

The centrodorsal is conical, pointed, 3.0 mm. in diameter at the base and 3.5 mm. high. The cirrus sockets are arranged in five midradial groups separated by interradial interspaces which are almost as broad as the areas occupied by the cirri. In each midradial group there are 5 or 6 closely crowded sockets, often forming an almost single row.

The cirri are XXVI, 15–17, from 15 to 20 mm. long, the smaller apical cirri with 10–12 segments and 5 or 6 mm. long. The first and second segments are short, the third is about as broad as long, the fourth is longer, the fifth to seventh are two-thirds again as long as broad, and the eighth or ninth and those following to the antepenultimate are not much longer than broad. The dorsal surface of the segments is slightly carinate and the distal dorsal ends are somewhat overlapping. There are no dorsal spines. The opposing spine on the distal portion of the penultimate segment is large, bifurcate, and often has a small lateral accessory spine. The terminal claw is longer than the penultimate segment and is slender, curved, and pointed.

The radials are visible as narrow bands in the interradial angles. The IBr_1 are four times as broad as long and are in close lateral apposition in the proximal half; they are narrowed in the midradial line by the posterior projection of the axillary. The IBr_2 (axillary) is pentagonal, twice as broad as long, like the IBr_1 with a slight median carination but otherwise rounded dorsally. The IIBr series are 2 and resemble the IBr series. The ossicles immediately following the axillaries are in close lateral apposition in the proximal half.

The 19+ (probably originally 20) arms are 60 mm. long; in four cases they are broken off at the synarthrial articulation between the first two brachials. The first two brachials have a slight synarthrial tubercle. The first 12 brachials are discoidal, those following becoming wedge-shaped. The fifth to tenth brachials have the distal ends a little overlapping, those following being smooth. The arms are laterally flattened as far as the fourth brachial. Seven or 8 of the terminal brachials bear rudimentary pinnules.

Of the two arms given as samples of the distribution of the syzygies by Gislén, one has the first four brachials united in two synarthrial pairs and the syzygies between brachials 21+22, 31+32, and 41+42. The other also has the first four brachials united in two synarthrial pairs and syzygies between brachials 17+18, 26+27, 35+36, and 44+45.

P_1 is 3.5 mm. long with 13 segments. P_2 is 4.5 mm. long with 12 segments. P_3 is 4 mm. long with 11 segments. P_4 is 3.5 mm. long with 10 segments. The segments on the first three pinnules are rather uniform, from twice as broad as long to as long as broad; on the outer side of the third and following segments there are small winglike flanges partly caused by small notches between the segments. On P_3 to P_{12}, which are 3.5 to 4 mm. long with 10 or 11 segments, the third to fifth or sixth segments are flattened dorsoventrally, cup-shaped with winglike borders; the seventh to eleventh segments are narrow and long again. In dorsal view the cup-shaped segments are about as long as broad, the distal over twice as long as broad. The distal pinnules are 4 mm. long with 11 segments of which the first is short, the second is about as long as broad, the third to tenth are half again as long as broad, and the terminal segment is short. All the segments are smooth.

The disk has been thrown off. Sacculi are rather scarce.

The color is light brown.

Notes.—In one of the two specimens from Mortensen's station 9 as described by Gislén the centrodorsal is conical, 3 mm. broad at the base and 3.5 mm. high. The cirri are arranged as in the type specimen with from 3 to 6 in each radial group. The cirri are XXII, 18, 16 mm. long, those near the dorsal pole with 12 segments and only 6 mm. long. The opposing spine is bifurcate.

The IBr_1 are five times as broad as long. The IBr_2 (axillaries) have a median carination in the proximal three-fourths. The IIBr series are 2.

The 16 arms are all broken in the distal portion. From about the fifth to the twenty-fifth brachials the distal borders are rather strongly everted and collar-shaped. After about the twentieth brachial there is a weak median carination.

The intersyzygial interval is four or five muscular articulations.

P_1 is 4 to 5 mm. long with 15 segments. P_2 is 4.8 to 5.5 mm. long with 14 segments. P_3 is 4.7 mm. long with 10 segments. P_5 is 4.5 mm. long with 10 segments. The disk is 5 mm. in diameter and is covered with coarse calcareous granules. The anal cone is inflated and wart-shaped, 1.5 mm. high.

The color is a very bright brown.

In the other specimen from Mortensen's station 9 the cirri are XXVIII, 16–18, 18 mm. long, the apical cirri with 12–14 segments and 9–12 mm. long. The dorsal carination of the segments is well marked. In one case the opposing spine is doubled, thus giving rise to four opposing spines on the penultimate segment. The centrodorsal is 3.5 mm. broad at the base and 4 mm. high. The radials are visible as flaps in the interradial angles. The IBr_1 are six times as broad as long. All the postradial series are broken off at the synarthry in the IBr series.

Gislén wrote that this specimen had been sacrificed for more detailed study. The cirrus sockets are, as evident from the figure, provided with short and broad incomplete septa, from 10 to 15 in number. The lumen, which is transversely oval, is surrounded by a low areola as in certain Cretaceous comatulids. There are broad interradial areas on the centrodorsal free of cirri. New cirri are appearing on the ventral face of the centrodorsal between this face and the radial ring. The centrodorsal cavity is nearly as large as that of *Leptometra.* The basals are not visible externally. The free dorsal part of the radials protrudes only in the interradial angles. The radial ring is 4 mm. broad and 2 mm. high. The muscular fossae are high and narrow, excluding the interarticular fossae from the neighborhood of the lumen. The radial cavity is 0.8 mm. in diameter, comparatively small, and is filled by a porous calcareous plug. This calcareous plug also fills the cavity of the ring that is formed by the five IBr_1.

Localities.—Dr. Th. Mortensen's Pacific Expedition 1914–16, station 9; southern Japan, off Kiu Shiu (lat. 32°15′ N., long. 128°12′ E.); 162 meters; hard bottom; May 15, 1914 [Gislén, 1927, 1934].

Albatross station 4894; Eastern Sea from 10 to 20 miles southwest of the Goto Islands; Ose Saki Light bearing N. 41° E., 5 miles distant (lat. 32°33′ N., long. 128°32′10″ E.); 174 meters; green sand, broken shells, and pebbles; August 9, 1906 [A. H. Clark, 1907, 1908, 1909, 1912, 1915, 1918] (1, U.S.N.M., 22633).

Dr. Sixten Bock's Expedition to Japan 1914; station 56; Bonin Islands, east of the Channel; 210 meters; shells and sand; August 15, 1914 [Gislén, 1922, 1924, 1927, 1934].

Geographical range.—From southwestern Japan to the Bonin Islands.

Bathymetrical range.—From 165 to 210 meters.

History.—This species was described in 1907 under the name of *Antedon garrettiana* from a single specimen from *Albatross* station 4894. Later in the same year it was transferred to the new genus *Charitometra.* In 1908 *Charitometra garrettiana* was listed as a Japanese species. In 1909 *garrettiana* was made the type of the new genus *Chlorometra.* In my memoir on the crinoids of the Indian Ocean published in 1912 *Chlorometra garrettiana* was listed and the synonymy and range were given. In 1915 it was again listed as a Japanese species and the range and its significance were discussed. In my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 *Chlorometra garrettiana* was included, and I gave the synonymy and range.

Diodontometra bocki was described and figured by Prof. Torsten Gislén in 1922 from a single specimen collected by Dr. Sixten Bock in the Bonin Islands in 1914. In 1924 Gislén described and figured the syzygies and the pinnule articulations. In 1927 he recorded and gave notes on two additional specimens that had been dredged by Dr. Th. Mortensen off southwestern Japan, figuring certain details of the structure. In 1934 he listed *Diodontometra bocki* as representing a special type of arm division.

Genus GLYPTOMETRA A. H. Clark

Antedon (part) P. H. Carpenter, Pop. Sci. Rev., vol. 4, No. 15, 1880, p. 194, and following authors.

Charitometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361.

Glyptometra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 18 (diagnosis; genotype *Antedon tuberosa* P. H. Carpenter, 1888), p. 83 (ornamentation compared with that of *Pachylometra investigatoris*); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 10 (represented in the West Indies by *Crinometra*); Crinoids of the Indian Ocean, 1912, p. 9 (absent from Australia), p. 10 (occurs at the Hawaiian Islands [*Pachylometra lateralis*]), p. 11 (absent from the west coast of the Malay Peninsula, the Andamans, and from farther west), p. 13 corresponds in part to the West Indian *Crinometra*), p. 24 (range; for zoogeographical purposes may well be considered as one with *Pachylometra* and *Crinometra*), p. 60 (in key), p. 224 (original reference; type); Internat. Rev. gesamt. Hydrobiol. und Hydrogr., 1914, pp. 4 and following (in part represents *Crinometra* of the Atlantic; range); Die Crinoïden der Antarktis, 1915, p. 125 (certain species show the characteristic features of *Anthometra adriani*), p. 181 (range; represents, in part, *Crinometra* of the Atlantic); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 173 (in key; range), p. 190.—Gislén, Vidensk. Medd. Dansk Nat. Foren., vol. 83, 1927, p. 35; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 20.

Pachylometra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 20 (diagnosis; genotype *Antedon distincta* P. H. Carpenter, 1888); Vid. Medd. Nat. Foren. København, 1909, p. 147 (the species of this genus agree in the variation of the IIBr series with the species of the West Indian *Crinometra*); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 10 (represented in the West Indies by *Crinometra*), p. 13 (common to southeast Africa and the Bay of Bengal, but not occurring in the Arabian Sea); Crinoids of the Indian Ocean, 1912, p. 11 (occurs both east and west of Ceylon), p. 12 (represented in the Red Sea and in the southeast African regions), p. 13 (corresponds in part to the West Indian *Crinometra*), p. 24 (range; for zoogeographic purposes may well be considered as one with *Glyptometra* and *Crinometra*), p. 60 (in key), p. 215 (original reference; type).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 286 (discussion).—A. H. Clark, Internat. Rev. Gesamt. Hydrobiol. und Hydrogr., 1914, pp. 4 and following (in part represents the Atlantic *Crinometra;* range); Die Crinoïden der Antarktis, 1915, p. 125 (certain species show the characters of *Anthometra adriani*), p. 164 (range), p. 181 (range; represents *Crinometra*).—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Pap. 90–L, 1915, p. 195 (inorganic constituents of the skeleton); Prof. Pap. 102, 1917, pp. 23 and following (same).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 173 (in key; range), p. 184 (key to the included species).—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Pap. 124, 1922, p. 20 (inorganic constituents of the skeleton).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 120; Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8; Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, pp. 480, 481, 482; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 22; Kungl. Svenska Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, October 3, 1938, p. 5.

Crossometra A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 606 (diagnosis; genotype *Pachylometra investigatoris* A. H. Clark, 1909; range; included species); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 173 (in key; range), p. 174 (key to the included species.—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 119; Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8 (notes); Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 482.

Perissometra A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 606 (diagnosis; genotype *Antedon flexilis* P. H. Carpenter, 1888; range; included species); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 173 (in key; range), p. 176 (key to the included species).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, pp. 10, 120; Vid. Medd. Dansk Nat. Foren. København, vol. 83, 1927, pp. 2, 35; Ark. Zool., vol. 19, No. 32, Feb. 1928, pp. 8, 9.—A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 656.—Gislén, Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 481; Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20, 23.

Calyptometra A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 608 (diagnosis; genotype *Charitometra lateralis* A. H. Clark, 1908; range; included species); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 174 (in key; range), p. 189.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 18, 20.

Glytometra Preston, Zool. Record for 1928, 1929, p. 32 Echin.

Diagnosis.—A genus of Charitometridae in which the genital pinnules taper evenly from the usually more or less broadened earlier segments to a delicate tip, the portion beyond the gonad being much longer than the gonad itself; the division series and arms are rounded dorsally, with or without a fine median abruptly raised line and a tubercular ornamentation on the division series and arm bases; and the oral pinnules are little or not at all longer than the genital and distal pinnules.

Geographical range.—East Africa from Sokotra southward to East London, South Africa, and eastward to Timor, the Sahul Bank, the Kermadec Islands, Fiji, and the Hawaiian Islands, and northward to southern Japan.

Bathymetrical range.—From 55 to 2,194 meters.

Thermal range.—From 4.17° to 15.00° C.; the average of all records is about 7.90° C.

Remarks.—As explained in the discussion of the family, there are no valid grounds for maintaining the genera *Pachylometra*, *Crossometra*, *Perissometra*, and *Calyptometra* as distinct from the earlier *Glyptometra*. Even with their inclusion the 15 species herein recognized as constituting the genus *Glyptometra* form a very homogeneous unit the specific lines within which are by no means always well marked—indeed it is quite possible that some of the species now recognized are merely varieties or local forms of others.

The species appear to be divisible into two groups in one of which the cirri are stout with short segments, whereas in the other they are more slender with longer segments. Although this division seems to be valid as far as the formation of a key is concerned, it should be pointed out that there is an almost continuous sequence from species in which all the cirrus segments are much broader than long to species in which all but two or three of the basal segments are much longer than broad. In both groups the number of arms in the included species runs from 10 to 32 or 33, and in both groups the division series and arm bases may be plain or may have a more or less developed usually rugose ornamentation. In both groups the subdivisions are based upon the relative length of the proximal and distal cirrus segments and the ornamentation. In the group with slender and long-segmented cirri the arrangement of the cirrus sockets on the centrodorsal, whether in 10 or 15 columns, seems to be significant when fully matured individuals are compared, though species normally with 15 columns of cirrus sockets when adult may have only 10 when young.

History.—The species of this genus known to Carpenter were assigned by him to *Antedon*. All of them were transferred to *Charitometra* when I established that genus in 1907. In 1909 I transferred some of the species of *Charitometra* to the new genera *Glyptometra* and *Pachylometra*, and in 1916 I established the genera *Crossometra* and *Perissometra* for species previously included in *Pachylometra*, and *Calyptometra* for one of the species included in *Glyptometra*.

KEY TO THE SPECIES IN THE GENUS GLYPTOMETRA

- a^1. Cirri stout, the longest segments at most only slightly longer than broad.
  - b^1. All the cirrus segments much broader than long, the longest from half again to twice as broad as long; ossicles of the IBr series and first four brachials with the dorsal surface raised into a broad blunt median tubercle, highest and most conspicuous on the division series; brachials in the proximal fourth or third of the arm with indications of a broad low median tubercle; 10 arms 165 mm. long; cirri with 17–20 segments, 20–25 mm. long (Timor to northern Celebes; 457–520 meters) .... **timorensis** (p. 230)
  - b^2. Longest cirrus segments about as long as broad or slightly longer than broad.
    - c^1. Lower brachials with the distal ends thickened or everted, standing up more or less prominently above the general surface of the ossicles; 10–20 arms 100–180 mm. long; IIBr series usually 4 (3+4) (Celebes to the Kei Islands and Timor and west to the Nicobar Islands; 245–1,023 meters) .... **crassa** (p. 237)
    - c^2. Lower brachials smooth, without projecting distal ends.
      - d^1. Cirri of uniform width throughout, all the segments subequal, about as long as broad; 11–20 arms 100–145 mm. long (Philippines to Fiji and the Kermadec Islands; 1,152 meters) .... **inaequalis** (p. 343)
      - d^2. Cirri broader distally than proximally, the longest segments about as long as broad, the distal becoming slightly broader than long; 33 arms 130 mm. long (southern Japan; 366 meters) .... **septentrionalis** (p. 246)
- a^2. Cirri more slender, the longest segments, and often all the segments, markedly longer than broad.
  - b^1. Ossicles of the division series and all, or nearly all, the brachials with a low, narrow, sharp median keel of uniform height; ossicles of the division series and earlier brachials with abruptly everted borders and more or less numerous small beady tubercles or capitate spines scattered over the dorsal surface; 10–18 (usually 10–12) arms 100–140 mm. long; IIBr series, when present, 4(3+4) or 2 (northern Philippines to the Kei Islands; 245–929 meters). **tuberosa** (p. 232)
  - b^2. No narrow median raised line on the ossicles of the division series and arms, which are without small beady or capitate tubercles.
    - c^1. Cirrus sockets arranged in 10 columns on the centrodorsal.
      - d^1. Cirri stouter, the distal segments not longer than broad.
        - e^1. Distal cirrus segments broader than long; 14–33 arms 100–205 mm. long (northern Mindanao to the Kei Islands; 252–773 meters) .... **distincta** (p. 249)

e^2. Distal cirrus segments about as long as broad.
  f^1. Division series and proximal brachials smooth; 18–32 arms 110–170 mm. long; cirri with 20–31 segments; P_D with 50–53 segments (northern Luzon southward to Timor; 55–520 meters)---------------------------------**investigatoris** (p. 254)
  f^2. Division series and arm bases rugose; 13–15 arms 130–170 mm. long; cirri with 15–22 segments; P_1 with 30 segments (Timorlaut to the Laccadive Islands and the Seychelles; 914–1,462 meters)---------------------------------**macilenta** (p. 259)
d^2. Cirri more slender with the distal segments all longer than broad; division series and arm bases smooth, not rugose; 11–20 arms.
  e^1. Proximal portion of the animal constricted, the sides of the IBr series being nearly parallel, the IIBr series somewhat abruptly turned outward (Meangis Islands; 914 meters)--**angusticalyx** (p. 263)
  e^2. Proximal portion of the animal not constricted.
    f^1. Division series and arm bases moderately broad; cirri with up to 21 segments (off Sokotra; 2,194 meters)-------------------------------------**sparksi** (p. 266)
    f^2. Division series and arm bases broader; cirri with 16 segments (vicinity of East London, South Africa; 548–566 meters)------------------------------**sclateri** (p. 268)
c^2. Cirrus sockets arranged in 15 columns on the centrodorsal.
  d^1. Division series and arm bases smooth, without ornamentation; 12–14 arms 100 mm. long; cirri with 14–15 segments (Philippines; 329–1,334 meters)---------**levigata** (p. 271)
  d^2. Division series and arm bases with rugose ornamentation.
    e^1. Outermost cirrus segments about as long as broad or broader than long; lateral edges of the ossicles of the IBr series and earlier brachials not turned outward; 10 arms 115–130 mm. long (southern Japan; 660 meters)--------------------------**lata** (p. 272)
    e^2. Outermost cirrus segments, like those preceding, markedly longer than broad; lateral edges of the elements of the division series and earlier brachials turned outward.
      f^1. Rugose ornamentation finer, the proximal brachials each with a small rounded central tubercle; 12 arms 170 mm. long; cirri with 20–21 segments, 30–34 mm. long (off South Andaman Island; 1,040 meters)-----------------------**invenusta** (p. 275)
      f^2. Rugose ornamentation coarse, the proximal brachials each with a low broad hump; cirri with 15–21 segments, 30–40 mm. long; 10–11 arms 160–180 mm. long (Hawaiian Islands; 583–824 meters)----------------------------------**lateralis** (p. 276)

GLYPTOMETRA TIMORENSIS A. H. Clark

PLATE 21, FIGURES 66, 67

[See also vol. 1, pt. 1, fig. 100, p. 162.]

Glyptometra timorensis A. H. CLARK, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 80 (description; *Siboga* station 297).

Perissometra timorensis A. H. CLARK, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. IX (relationship with *P. lata*), p. 177 (in key; range), p. 182 (detailed description; Sta. 297), p. 183, fig. 7, p. 275 (listed), pl. 24, fig. 71.—GISLÉN, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8.

Diagnostic features.—All the cirrus segments are much broader than long; the cirrus sockets are arranged in 10 columns on the centrodorsal; the 10 arms are up to 165 mm. in length; the ossicles of the division series and proximal brachials have the lateral and the outer part of the proximal and distal edges everted and more or less crenulate or scalloped; and the cirri are 20–25 mm. long with 17–20 segments.

Description.—The centrodorsal is very thick-discoidal, the sides sloping slightly inward, 6.5 mm. in diameter at the base and 3.0 mm. high. The cirrus sockets are arranged in 10 columns of 2 each, the columns closely crowded against each other and showing no separation into pairs.

The cirri are XX, 17–20, from 20 to 25 mm. long, and stout. The first segment is very short, the following gradually increasing in length to about the seventh which, with the following, is about twice as broad as the median length, or in the longest cirri half again as broad as the median length. The dorsal profile of the segments beyond the seventh or eighth is convex, becoming gradually more strongly so toward the end of the cirri where the segments are very bluntly carinate.

The ends of the basal rays are visible as flat triangular or irregular areas in the angles of the calyx.

The radials are entirely concealed, or slightly visible as small irregular tubercles or flat irregular areas in the interradial angles. The IBr_1 are short, broadly chevron-shaped, the proximal and distal borders parallel, about four times as broad as long; the proximal edge is produced into a thin border overlapping and concealing the proximal portion of the centrodorsal, though flush with its general surface; the border of this produced edge is usually irregularly scalloped or bears a few low coarse teeth, though it may be nearly plain; it may be evenly curved, becoming straight just over the ends of the basal rays, or it may be regularly curved in its lateral third but nearly straight in its median third; the middle of the dorsal surface of the IBr_1 is occupied by a large and prominent oval well rounded tubercle. The IBr_2 (axillaries) are broadly rhombic with the lateral angles truncated so that the lateral edges are from one-half to two-thirds the length of the sides of the IBr_1, two and one-half times as broad as long, in the median line nearly twice as long as the IBr_1; the center, except at the anterior angle, is occupied by a tubercle which is more elongated dorsoventrally than that on the IBr_1 and, though as high, is less prominent as it rises much less abruptly. The lateral edges of the elements of the IBr series are turned slightly outward. The lateral thirds of the proximal edge of the axillaries and the corresponding portions of the distal edge of the IBr_1 are also turned upward to the same height as the lateral edges; the eversion of the latter is most marked just over the ends of the basal rays and gradually decreases anteriorly to the distal corner of the lateral edge of the axillary, persisting, however, as far as the fifth brachial. The inner lateral edges of the first five brachials are similarly modified.

The 10 arms are 165 mm. long. The first brachials are wedgeshaped, slightly longer exteriorly than interiorly, twice as broad as the exterior length. The proximal border is narrowly produced. The outer border is produced like the lateral borders of the IBr_2. The inner border is similarly produced, especially at the distal angle, which is more or less rounded off and overlaps the proximal inner angles of the second brachials. The second brachials are of about the size and shape of the first, with the outer edge similarly produced; the production of the inner edge is like that of the outer, but it is not so marked. The first syzygial pair (composed of brachials 3+4) is oblong, about twice as broad as long, with the lateral edges turned outward as in the brachials preceding. The following brachials are slightly wedge-shaped, about twice as broad as long. One brachial between the ninth and thirteenth (usually the eleventh) is oblong, and those following quickly become triangular, about as long as broad. The first four brachials have a low and very broadly rounded median carination, which is very obscure; those following have an equally obscure slight and very broad convexity in the middle of the dorsal surface which, after the eighth or ninth, becomes smaller in area and resolves itself into a low rounded tubercle which gradually disappears after the end of the proximal third, though it may be detected as far as the end of the proximal half.

Localities.—*Siboga* station 297; Timor Sea (lat. 10°39′ S., long. 123°40′ E.); 520 meters; soft gray mud with brown upper layer; January 27, 1900 [A. H. Clark, 1912, 1916, 1918; Gislén, 1928] (4, U.S.N.M., E. 424, Amsterdam Mus.).

Menado Bay, northern Celebes (lat. 1°31′ N., long. 124°47′ E.); 457 meters; Captain Christiansen, cable repair ship *Nordiske*, Great Northern Telegraph Company, March 12, 1913 (5, C. M.).

Geographical range.—From the Timor Sea northward to northern Celebes.

Bathymetrical range.—From 457 to 520 meters.

History.—*Glyptometra timorensis* was described in 1912 on the basis of four specimens from *Siboga* station 297. It was referred to *Perissometra* on the establishment of that genus in 1916. In my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 *Perissometra timorensis* was described in detail and figured. In 1928 Prof. Torsten Gislén wrote that *timorensis*, together with *patula*, *lata*, *flexilis*, and *aranea* (=*Parametra orion*), should be included in the genus *Perissometra*, whereas all *Perissometras* with the IIBr series 4(3+4) ought to be referred to *Crossometra*.

GLYPTOMETRA TUBEROSA (P. H. Carpenter)

PLATE 22, FIGURE 69

[See also vol. 1, pt. 2, fig. 816, p. 385, pl. 34, fig. 1211.]

Antedon tuberosa VON GRAFF, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, p. 79 (*Challenger* sta. 210; myzostomes; *nomen nudum*).—P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, p. 126 (description; *Challenger* station 210), pl. 14, fig. 9, pl. 23, fig. 2.—HARTLAUB, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (systematic and bathymetrical relationships).—LANG, A text book of comparative anatomy, vol. 2, 1896, p. 375, fig. 326*c*.—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed), pl. 11, fig. 7 (pentacrinoid; from Carpenter).—A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 33 (identity).

Charitometra tuberosa A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed); Proc. U.S. Nat. Mus., vol. 34, 1908, p. 228 (compared with *Ch.* [*Calyptometra*] *lateralis*); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (type of a non-oceanic group).

Glyptometra tuberosa A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 19 (listed); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 407 (*Albatross* station 5236); vol. 39, 1911, p. 557 (*Albatross* stations 5367, 5406, 5431, 5510, 5536, 5537; 6-rayed specimen described; specimen with undivided post-radial series described); Crinoids of the Indian Ocean, 1912, p. 33 (identity), p. 224 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 49 (published reference to specimens in the B. M.; *Challenger* station 210; characters of the ornamentation); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 190 (synonymy); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, pl. 2, fig. 27 (side and covering plates).—GISLÉN, Zool. Bidrag Uppsala, vol. 9, 1924, p. 28, footnote; Vid. Medd. Dansk Nat. Foren. København, vol. 83, 1927, p. 33 (compared with *Perissometra aranea*), p. 35; Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 9, No. 41 (notes).—A. H. CLARK, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 658 (between Cebu and Leyte; 154 fathoms).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 22.

Diagnostic features.—A highly ornamented rather small and slender species; the ossicles of the division series and earlier brachials have abruptly everted borders, a low, narrow, sharp, and prominent median keel, and more or less numerous small beady tubercles or capitate spines scattered over the dorsal surface; the 10–18 (usually 10–12) arms are 100–140 mm. long; the IIBr series are 4(3+4) or 2; and the cirri, which are arranged in 10 rows on the centrodorsal, have 11–15 rather long segments.

Description.—The centrodorsal is a thick disk with a rough dorsal surface.

The cirri are XV–XX, 13–15. The fifth segment is the longest, and those following gradually acquire a dorsal keel which passes into the small opposing spine of the penultimate.

The radials are concealed. The IBr_1 are short and broad, laterally united, and the IBr_2 (axillaries) are pentagonal, short and broad, with a very obtuse distal angle. The elements of the IBr series and first four brachials are straight edged and sharply flattened laterally, and are more or less carinate in the median line. There are small blunt tubercles on the dorsal surface of the IBr series and arm bases.

The 10 arms are 125 mm. long and consist of nearly 150 brachials. The first brachials are oblong and closely united interiorly, the second more wedge-shaped; from the third to the tenth the brachials are discoidal with the distal edge more or less raised and crenulate, this feature disappearing on the brachials following, which are more triangular and elongate considerably toward the arm tips. The lowest brachials, especially on the younger arms, have a marked median keel which gradually dies away in the middle third, the terminal brachials being quite smooth. Carpenter's figure shows the elements of the IBr series and lower brachials with thickened and produced distal ends, a conspicuous and narrowly rounded median keel fused with the produced distal edge, somewhat everted lateral borders, and several small beadlike tubercles on the dorsal surface. In the larger specimen, which I examined at London in 1910, I found the ornamentation prominent and pearly; the median keels are not quite so prominent as they are shown in the figure. In the smaller specimen the keels are proportionately larger and more regular.

Syzygies occur between brachials 3+4, again from between brachials 11+12 to between brachials 27+28, and distally at intervals of from 5 to 13, usually 7 to 9, muscular articulations.

The pinnules of the first pair, P_1 and P_a are tolerably equal with 20–25 segments, the lowest of which are broad and slightly keeled. The next pinnules slowly increase in length and size and have the third and following segments expanded to cover the gonads, which are protected ventrally by strong plates; the fourth and fifth segments are larger than the rest, though not markedly so. This feature ceases rather beyond the first third of the arm and the pinnules then become more slender, with the basal segments as long as, or longer than, broad.

The disk is 5 mm. in diameter, much incised and paved with small plates. The ventral surface of the arms is moderately plated, and the pinnule ambulacra have distinct side plates with intervening sacculi, which are also abundant in the plating over the gonads.

In alcohol the arms are nearly white, the older ones a dark brownish gray.

The preceding description is adapted from the original description of Carpenter, with a few additions by Gislén and by myself based upon an examination of Carpenter's two specimens.

Notes.—The specimen from *Albatross* station 5367 has 18 arms; of the seven IIBr series present six are 4(3+4) and one is 2, the last bearing externally a IIIBr 4(3+4) series.

The specimen in the British Museum from between Cebu and Leyte has 10 arms.

The specimen from *Albatross* station 5406 has 12 arms with both IIBr series 2. It resembles the specimen from station 5367, but the dorsal carination of the division series and arm bases is slightly more prominent.

There are 22 specimens from *Albatross* station 5410. Of these, 17 have 10 arms, usually between 100 and 115 mm. long, those of the largest 140 mm. long. Three have 11 arms, the IIBr series being 2 in each case. One has 12 arms with both IIBr series 2. The last has 6 rays and 12 arms.

Of the 2 specimens from *Albatross* station 5536 one has 10 arms 125 mm. long; the other is of the same size with 12 arms, both the IIBr series being 2.

From *Albatross* station 5537 there are 2 nearly perfect specimens, both with arms 140 mm. long; both have regenerated disks. One has 12 arms, both IIBr series being 2. The other has 11 arms; there are two IIBr 2 series, but one postradial series is not divided, the IBr_2 bearing a pinnule instead of being axillary, as in *Eudiocrinus*.

In a very young specimen from *Albatross* station 5236, tentatively referred to this species, the lateral eversion of the elements of the IBr series and lower brachials is very pronounced, and the characteristic median carination is indicated on the IBr series and lower brachials; tubercles, however, have not as yet appeared. This individual is remarkable for the very large size of the external ends of the basal rays.

The 2 specimens from *Albatross* station 5510 each have 10 arms 100 mm. long.

One of the specimens from the Danish expedition to the Kei Islands station 56 has 10 arms about 80 mm. long. There are 11–13 cirrus segments. The edges of the radials and IBr_1 and the proximal edge of the axillaries are very strongly serrate, and the distal edges of the axillaries are strongly everted. The axillaries have a sharp median keel on either side of which is a single large tubercle. The first two brachials have a row of three large and sometimes also two or three small tubercles, the middle one largest, forming a blunt median keel. The first syzygial pair has a strongly and broadly everted distal edge which is sometimes lobate, and below this a transverse row of 5 or 6 tubercles of various sizes, the middle one always the largest. The following wedge-shaped brachials have the distal edge strongly and broadly produced—so broadly that almost the entire dorsal surface is involved. Below the produced distal edge there is a series of swellings, or more or less distinct tubercles; or the production may occupy the entire dorsal surface of the brachial. The triangular and following brachials have the distal border somewhat produced and usually more or less bluntly serrate; they bear a low and rounded median keel.

The pinnule segments are more or less produced at the edges, so that the borders of the pinnules are strongly serrate.

Another specimen from the same station has 10 arms 75 mm. long, and the cirri with 12–14 segments. The dorsal pole of the centrodorsal is irregularly tubercular. The elements of the IBr series are irregularly tubercular, the axillaries with strongly everted and irregularly crenulate edges and a high median keel. The first two brachials have an elongate median tubercle, everted and crenulate edges, and a rugose dorsal surface. The following brachials have a strongly everted distal edge and a rounded median tubercle fused with, or incorporated in, this everted distal border; as the brachials become obliquely wedge-shaped this transforms into a narrow and inconspicuous median keel that persists to the arm tips.

Of the remaining three specimens from this station one has 10 arms 75 mm. long and the cirri with 12–13 segments, and another is similar with 10 arms 70 mm. long.

Pentacrinoid.—A pentacrinoid larva presumably of this species was described by Carpenter (see Part 2, p. 523, pl. 34, fig. 1211).

Localities.—*Albatross* station 5367; Verde Island Passage; Malabrigo Light bearing N. 81° E., 8 miles distant (lat. 13°34′37″ N., long. 121°07′30″ E.); 329 meters; sand; February 22, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 35668).

Between Cebu and Leyte, Philippines (lat. 11°07′ N., long. 124°06′ E.); 282 meters [A. H. Clark, 1929] (1, B. M.).

Albatross station 5406; in the vicinity of Dupon Bay, Leyte; Ponson Island (N.) bearing S. 88° E., 10.2 miles distant (lat. 10°49′03″ N., long. 124°24′23″ E.); 479 meters; hard bottom; March 17, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 35667).

Albatross station 5410; between Cebu and Leyte; Bagacay Point Light bearing S. 37° W., 7.2 miles distant (lat. 10°28′45″ N., long. 124°05′30″ E.); 704 meters; green mud; March 18, 1909 [A. H. Clark, 1911, as station 5431] (19, U.S.N.M., 35666).

Albatross station 5423; Joló (Sulu) Sea; Cagayan Island (S.) bearing S. 11° E., 4.8 miles distant (lat. 9°37′05″ N., long. 121°12′37″ E.); 929 meters; bottom temperature 9.88° C.; gray mud and coral sand; March 31, 1909 (2, U.S.N.M., 35988).

Challenger station 210; off the Panglao and Siquijor Islands (lat. 9°26′ N., long. 123°45′ E.); 685 meters; bottom temperature 12.28° C.; blue mud; January 25, 1875 [von Graff, 1884; P. H. Carpenter, 1888; Hartlaub, 1895; Lang, 1896; A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1918; Gislén, 1924, 1927, 1928, 1934] (2+, B.M.).

Albatross station 5529; between Siquijor and Bohol; Balicasag Island (C.) bearing N. 11° E., 6.9 miles distant (lat. 9°23′45″ N., long. 123°38′30″ E.); 806 meters; bottom temperature 11.66° C.; gray mud and globigerinae; August 11, 1909 (1, U.S.N.M., 36095).

Albatross station 5536; between Negros and Siquijor; Apo Island (C.) bearing S. 26° W., 11.8 miles distant (lat. 9°15′45″ N., long. 123°22′00″ E.); 510 meters; bottom temperature 11.94° C.; green mud; August 19, 1909 [A. H. Clark, 1911] (2, U.S.N.M., 35665).

Albatross station 5537; between Negros and Siquijor; Apo Island (C.) bearing S. 46° W., 8.7 miles distant (lat. 9°11′00″ N., long. 123°23′00″ E.); 464 meters; bottom temperature 11.94° C.; green mud; August 19, 1909 [A. H. Clark, 1911] (2, U.S.N.M., 35664).

Albatross station 5236; off the east coast of Mindanao, Philippines; Magabao Island (S.) bearing N. 85° W., 9 miles distant (lat. 8°50′45″ N., long. 126°26′52″ E.); 903 meters; bottom temperature 5.17° C.; fine gray sand; May 11, 1908 [A. H. Clark, 1909] (1, U.S.N.M., 35662).

Albatross station 5510; in the vicinity of northern Mindanao; Camp Overton Light bearing S. 68° E., 9.1 miles distant (lat. 8°16′00″ N., long. 124°03′50″ E.); 773 meters; bottom temperature 11.66° C.; gray mud and fine sand; August 7, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 35663).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 56; 245 meters; May 10, 1922 (5, U.S.N.M., E. 3197; C. M.).

Erroneous locality.—*Albatross* station 5431 [A. H. Clark, 1911]. This is a typographical error for station 5410.

Geographical range.—From the northern Philippines to the Kei Islands.

Bathymetrical range.—From 245 to 929 meters.

Thermal range.—From 5.17° to 13.0° C.

History.—This species was first mentioned by Prof. Ludwig von Graff as *Antedon tuberosa* (*nomen nudum*) in 1884 in his account of the myzostomes of the *Challenger* expedition; he gave the locality as station 210. It was formally described and figured as *Antedon tuberosa* from one entire specimen and a second much broken from *Challenger* station 210 by Dr. P. H. Carpenter in his report on the comatulids of the *Challenger* expedition published in 1888. At the same time Dr. Carpenter described and figured a young pentacrinoid from the same station which he said must belong either to *Antedon tuberosa* or to *A. distincta*, the only two species dredged at this station. He said that from the appearance of the pentacrinoid he thought it should be referred to *A. tuberosa.* In 1895 Dr. Clemens Hartlaub discussed the systematic and bathymetrical relationships of *Antedon tuberosa.* In 1896 Carpenter's figure was reproduced by Lang, and in 1907 his figure of the pentacrinoid was reproduced by Dr. Otto Hamann.

In my first revision of the genus *Antedon* published in 1907 *tuberosa* was assigned to the new genus *Charitometra,* and in 1908 *Charitometra tuberosa* was compared with the new species *Ch. lateralis.*

In my revision of the family Thalassometridae published on January 9, 1909, *Antedon tuberosa* was made the type of a new genus, *Glyptometra*, and in a paper published on May 13, 1909, I recorded and gave notes on a young specimen from *Albatross* station 5236.

In a paper published in 1911 I recorded and gave notes on a number of specimens of *Glyptometra tuberosa* from *Albatross* stations 5367, 5406, 5431 (=5410), 5510, 5536, and 5537, mentioning a 6-rayed specimen and another with an undivided postradial series.

In my memoir on the crinoids of the Indian Ocean published in 1912 *Glyptometra tuberosa* was listed and the synonymy and range were given, the latter as Philippine Islands in 51–423 fathoms. The depth 51 fathoms is that of *Albatross* station 5431, an erroneous locality. In a paper on the crinoids of the British Museum published in 1913 I gave notes on Carpenter's two original specimens which I had examined in London in 1910.

In my memoir on the unstalked crinoids of the *Siboga* expedition published in 1918 *Glyptometra tuberosa* was listed and the synonymy given. In the key to the genera of the family Charitometridae the bathymetrical range of the genus *Glyptometra* was given as 92–761 meters, the first figure, as in 1912, referring to *Albatross* station 5431.

In 1924 Prof. Torsten Gislén mentioned the pentacrinoid of *Glyptometra tuberosa* described by Carpenter in 1888, in 1927 he compared this species with *Perissometra aranea*, and in 1928 he published a note on the specimens in the British Museum.

In 1929 I recorded a specimen from between Leyte and Cebu in 154 fathoms, and in 1934 Dr. Gislén discussed the arm branching of the species.

GLYPTOMETRA CRASSA (A. H. Clark)

PLATE 21, FIGURE 68

Pachylometra crassa A. H. CLARK, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 77 (description; *Siboga* station 259).

Perissometra crassa A. H. CLARK, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 177 (in key; range), p. 181 (detailed description; station 259), p. 275 (listed), pl. 24, fig. 66.—GISLÉN, Vid. Medd. Dansk Naturh. Foren. København, vol. 83, 1927, p. 35.—A. H. CLARK, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 658 (compared with *P. occidentalis*).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 22.

Perissometra gorgonia A. H. CLARK, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607 (listed; *nomen nudum*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 177 (in key; range), p. 179 (detailed description; stations 254, 294), pp. 274, 275 (listed); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 658 (south of the Nicobar Islands; 560 fathoms; notes).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 22.

Diagnostic features.—The longest earlier cirrus segments are nearly as long as broad, the distal being somewhat shorter and usually with a small well-rounded subterminal dorsal tubercle; the lower brachials have the distal edges prominently everted or thickened, usually forming conspicuous half rings across the dorsal surface of the arms; the 10–20 arms are 100–180 mm. long; and the cirri are 25–32 mm. long with usually about 20 segments.

Description of the type specimen.—The centrodorsal is very large, 5 mm. across the irregularly convex dorsal pole and 5 mm. high; it is truncated conical, the sides making a rather small angle with each other. The cirrus sockets are arranged in 10 columns, usually 3 to a column; the columns are closely crowded interradially and slightly separated in the midradial line

The cirri are about XXV, 18–22 (usually 20), from 25 to 32 mm. long, stout and short–segmented. The first segment is short, those following gradually increasing in length so that the sixth and following are nearly as long as broad, those in the distal third of the cirri being slightly shorter again. On the seventh a slight broad subterminal dorsal hump makes its appearance which slowly increases in height so that the terminal nine possess a prominent broad, blunt, and well-rounded subterminal tubercle which becomes more pointed on the last two or three before the penultimate. The opposing spine is small, subterminal, resembling the tubercle on the preceding segment, but arising from a much smaller base.

The ends of the basal rays are concealed.

The radials are concealed. The IBr_1 are very short, broadly V-shaped, sometimes concealed in the median line so that only the lateral portions are visible; the dorsal surface is more or less irregular. The IBr_2 (axillaries) are short and broad, nearly three times as broad as long, rhombic with the lateral angles truncated so that the lateral edges are nearly or quite as long as those of the IBr_1. The IIBr series are 4(3+4).

The 10–11 arms are about 180 mm. long. The first two brachials are about equal in size, slightly wedge-shaped (more pronouncedly so on the second), about three times as broad as the median length. The broad and smooth synarthrial tubercles are scarcely marked. The brachials have slightly produced distal edges and a more or less swollen dorsal surface.

Notes.—The specimens from Menado Bay, Celebes, and those from the Danish Expedition to the Kei Islands stations 3, 8, 12, 58, and 59, were regarded as representing a new species which was called *annae.* Although this name was never published the specimens in the Copenhagen Museum, some of which may have been distributed to other museums, all bear it so that it is well to mention it in order that their true identity may be known.

All four of the specimens from Menado Bay have 10 arms. In one the dorsal pole of the centrodorsal is thickly and conspicuously vermiculated with short meandering rounded ridges of various lengths but of uniform height. The ends of the basal rays are strongly and irregularly tubercular. The IBr_1 are very short, with the entire surface irregularly tubercular. The IBr_2 (axillaries) have a high rounded median keel, the dorsal surface in the distal half is strongly and coarsely tubercular, and the proximal border is finely and irregularly dentate. The first brachials have the surface coarsely tubercular, the lateral edges rather broadly and strongly everted, and the proximal border narrowly everted. The surface of the second brachials is much less irregular. One of the other three is similar to this, but the other two have less strongly developed ornamentation.

The seven specimens from the Danish Expedition to the Kei Islands station 3 all have 10 arms which in one reach a length of 105 mm.

The three specimens from the Danish Expedition to the Kei Islands station 8 all have 10 arms which are 115, 75, and about 30 mm. long.

The type specimen of *annae* from the Danish Expedition to the Kei Islands station 12 in the Zoological Museum at Copenhagen may be thus described.

The centrodorsal is discoidal, rather thick, with moderately converging sides and a broad flat obscurely papillose dorsal pole 2 mm. in diameter. The cirrus sockets are arranged in 10 columns of 2, or more rarely 3, each.

The cirri are XX, 15–17 (usually 16), 20 mm. long. The first segment is very short, the second is about four times as broad as long, the fourth is about as long as broad, and those following are in the longest cirri slightly longer than broad and in the short cirri about as long as broad. The three or four segments preceding the penultimate have the distal border dorsally slightly swollen.

The ends of the basal rays are visible as rather prominent tubercules in the interradial angles of the calyx.

The radials are entirely concealed. The IBr_1 are partially concealed, appearing as a more or less narrow strip beyond the rim of the centrodorsal; their distal border is thickened and everted, and scalloped or coarsely and prominently tubercular. The IBr_2 (axillaries) are regularly rhombic, from two and one-half to three times as broad as long, with a high and conspicuous well-rounded ridge occupying the entire median line and the edges irregularly thickened or with occasional irregularly placed tubercles. The IBr series are broad, only slightly convex dorsally, in close lateral apposition, and, in common with the first two brachials, sharply flattened laterally.

The 10 arms are 100 mm. long. The first brachials are very short, roughly half again as long exteriorly as interiorly, with the central portion more or less abruptly swollen and the lateral edges more or less extensively thickened. The interior borders of adjacent first brachials are in close apposition. The second brachials are more than twice as large as the first. From the outer side the proximal and distal borders run parallel to about the midline, then converge and meet in a more or less sharp point over the inner ends of the first brachials. The surface is scarcely modified. The first syzygial pair (composed of brachials 3+4) is somewhat longer interiorly than exteriorly, and is usually about three times as broad as the median length. The surface of both the hypozygal and epizygal is somewhat swollen, and each has a more or less conspicuous large median tubercle. The next eight brachials are slightly wedge-shaped, four or five times as broad as the median length. The distal half is rather abruptly thickened, standing up as a thick transverse band across the arm. The segments following soon become almost triangular, slightly broader than long, with the distal portion unmodified, except that the distal edge is very finely spinous. On the short brachials following the first syzygial pair the median portion shows a more or less marked broad rounded tubercle; on the longer brachials following this becomes a fairly conspicuous low narrow rounded median carination which is traceable to the arm tips.

P_1 is 6–7 mm. long with 17–20 segments, slender and flexible, tapering gradually and regularly from the base to the tip. The first segment is about two and one-half times as broad as long, and those following very slowly increase in length, the terminal being about as long as broad. The proximal border of the segments is in the form of an obtuse angle the apex of which is truncated by the straight distal border of the segment preceding. On the first seven or eight segments the two free sides are straight and parallel with the axis of the pinnule; beyond this the sides curve inward from the distal angles.

P_2 is of the same length as P_1 or very slightly longer or shorter, and is composed of 15–17 segments. It resembles P_1 but is slightly less broad basally and also tapers more gradually so that it appears stouter in the distal half.

P_3 is usually 6 mm. long with 14 segments, resembling P_2 but stouter; it may, however, be slightly longer than the pinnules preceding, 7 mm. long with 15 segments of which the fifth is somewhat and the sixth is considerably enlarged, the next two segments decreasing in width rather rapidly so that those beyond are slender and twice as long as broad. On some pinnules the fifth to eighth segments are all almost equally enlarged.

P_4 is 7 mm. long with 15 segments of which the fourth and fifth are considerably enlarged, and those following slowly decrease in size. The gonads are completely protected ventrally by numerous stout plates of various sizes.

The pinnules following resemble P_4. The distal pinnules are 7 mm. long with 18–19 segments which have slightly everted and very finely spinous distal ends.

The disk is almost completely covered with papilliform granules.

Another specimen from the Danish Expedition to the Kei Islands station 12 has 14 arms 120 mm. long; two of the post-radial series bear two IIBr series; in each case that to the left is 4(3+4) and that to the right is 4. A third specimen has 12 arms 70 mm. long, two IIBr 2 series being present. A fourth has 11 arms 70 mm. long. The fifth has 10 arms 90 mm. long.

The specimens from the Danish Expedition to the Kei Islands station 56 were originally regarded as representing a new species which was called *Glyptometra hector*. The type specimen may be described as follows:

The centrodorsal is truncated conical, about twice as broad at the base as high, with a rather small, smooth, and slightly convex dorsal pole. The cirrus sockets are arranged in 10 columns of 3 or 4 each. These columns are closely crowded against each other interradially but in the midradial line they are separated by a V-shaped area, more or less irregular, which at the rim of the centrodorsal varies from as broad as the adjacent cirrus sockets to only half that width.

The cirri are about XXXV, 18–19, very stout, about 30 mm. long. The first segment is extremely short, and the second is usually about twice as broad as long, though it may be broader, or when the cirri are closely crowded it may be as long as broad. The segments following increase in length so that the sixth is about as long as broad. The next two are slightly longer than broad, and those succeeding are shorter again, in the distal third of the cirri being from one-third to one-half again as broad as long. The antepenultimate segment is slightly less in width than the segments preceding, and varies from about one-third again as long as broad to as long as broad. The last six to eight segments before the antepenultimate have the distal end dorsally extending somewhat beyond the base of the succeeding segment, which in lateral view is usually more or less rounded off, and the dorsal midline of these segments is obscurely carinate. The opposing spine is small, conical, terminal, and directed obliquely forward. The terminal claw is about as long as the penultimate segment, rather stout, and moderately and evenly curved.

The ends of the basal rays are visible as large irregular tubercles in the interradial angles.

The radials are visible as usually large triangles, broader than high, that extend downward between the topmost cirrus sockets in the free midradial triangles on the centrodorsal; touching the basal angles of these radial triangles there are long usually more or less lenticular tubercles extending diagonally forward between the ends of the basal rays and the lateral borders of the IBr_1; rarely these are reduced to more or less circular conspicuous capitate tubercles. The IBr_1 are very short, with the lateral borders very strongly diagonal or divergent, as a result of the presence of the long tubercles representing the anterolateral portion of the radials, and with the distal border more or less strongly concave. The median third of the dorsal surface is raised into a broadly rounded prominence. The IBr_2 (axillaries) are twice as broad as long, or even broader, triangular or more or less rhombic, with most or all of the median portion raised and broadly rounded, corresponding to the raised center of the IBr_1. The IIBr series are 4(3+4), all 10 being present and similar. They are very closely appressed laterally and are sharply flattened against each other. The profiles of the division series and arm bases on opposite sides make an angle of 45° with each other. The lateral borders of the elements of the IIBr series are abruptly everted, especially interradially. This eversion is greatest on the $IIBr_1$, less on the $IIBr_2$, and is scarcely noticeable on the two outer segments. A prominent rounded carination occupies the midline of the $IIBr_1$ and $IIBr_2$, and is represented in much reduced form on the syzygial pair.

The 20 arms are 160 mm. long. The earlier brachials have broad, low, and inconspicuous median tubercles which are continued distally as a barely traceable carination that is absent from some arms.

A small specimen from the same station has 10 arms 90 mm. long. The cirri are 15 mm. long with 13–14 segments. The ends of the basal rays are very large, and the radials, which are nearly half as long as the IBr_1, are more or less crescentic, their lateral borders turning anteriorly along the sides of the ends of the basal rays. The elements of the IBr series have a high well rounded median carination, and the lateral borders are somewhat everted. There is a faint indication of a broad low carination on the arms.

One of the specimens from the Danish Expedition to the Kei Islands station 58 has 18 arms 90 mm. long; of the eight IIBr series present six are 4(3+4) and two are 2; one of the post-radial series bears two arms only. Another has 13 arms 100 mm. long; of the three IIBr series present two are 4(3+4) and one is 2. Another has 13 arms 80 mm. long, there being three IIBr 4(3+4) series. The other two have 10 arms which in one are 85 mm. long.

One of the specimens from the Danish Expedition to the Kei Islands station 59 has 16 arms 100 mm. long; of the six IIBr series present four are 2 and two are 4(3+4); the ornamentation is well developed. Another specimen has 10 arms 80 mm. long; the carination of the IBr series and first two brachials is very low and inconspicuous; the earlier brachials have strongly produced distal edges, but the brachials are without median tubercles or carination. A third has 10 arms 70 mm. long; the edges of the elements of the IBr series and the proximal edge of the axillary are scalloped or tubercular; the keel on the IBr series and first two brachials is fairly well developed, and the broad median tubercles and later low blunt keels on the brachials, though very obscure, may be made out on most of the arms. A fourth specimen has 10 arms about 70 mm. long; the ornamentation is very slight, the carination on the elements of the IBr series being scarcely indicated, and the median elevation on the brachials being broad and exceedingly faint. A fifth specimen has 10 arms 55 mm. long; the elements of the IBr series and first two brachials are unornamented except for the median keel; the distal edges of the proximal brachials are thickened and moderately produced; the median elevation is very slightly marked. Another specimen has 10 arms 95 mm. long; the ornamentation is typically developed. The three remaining specimens are small with 10 arms which in one are only 25 mm. in length.

A specimen from *Siboga* station 294 was described under the name of *Perissometra gorgonia* in the following terms:

The centrodorsal is small, apparently conical. The cirrus sockets are arranged in 10 closely crowded columns.

The cirri are XXIV, 19–24 (usually 21), from 25 to 40 (usually between 30 and 35) mm. long. The cirrus segments are very uniform in length, the sixth and seventh and following being slightly longer than broad. The distal ends of the segments are slightly prominent, and the distal ends of those in the outer half are slightly thickened on the dorsal side.

The ends of the basal rays are visible as very large rhombic or rounded-triangular low tubercles or flat areas in the angles of the calyx.

The radials are concealed. The IBr_1 are extremely short, in the angles of the calyx running far upward and meeting over the ends of the basal rays; they bear a low broad median tubercle. The IBr_2 (axillaries) are rhombic, about two and one-half times as broad as long. Except in the median line their edges, like those of the IBr_1, are slightly everted. They bear a large, low, and broad median tubercle. The IIBr series are all 4(3+4); each of the component ossicles carries a low rounded median tubercle and has slightly thickened edges all around.

The 20 arms are about 170 mm. long. The earlier brachials have slightly thickened and more or less everted distal edges which as the brachials become triangular change to simple overlapping distal ends. Traces of a rounded median tubercle may be found at least as far as the end of the proximal third of the arm.

The specimen from *Siboga* station 254 has 17 arms 130 mm. long. Of the IIBr series five are 4(3+4) and two are 2. The cirri are rather slender, XXV, 14–16, 16 mm. long.

One of the specimens from south of the Nicobar Islands, which were referred to *G. gorgonia* with some hesitation, is very large but badly broken. The arms were apparently 20 in number. One of the IIBr series is 2, the others being 4(3+4). The edges of the ossicles of the division series and brachials are much less prominent than in the specimen from *Siboga* station 294, while there is scarcely an indication of the median tubercle beyond the lowest brachials. The cirri have 17–22 segments. With this there is a very small specimen with 11 arms 50 mm. long, one IIBr 4(3+4) series being developed.

Localities.—Menado Bay, Celebes (lat. 1°31′ N., long 124°47′ E.); 457 meters; Captain Christiansen, Great Northern Telegraph Co., March 12, 1913 (4, C. M.).

Siboga station 259; Kei Islands (lat. 5°29′12″ S., long. 132°52′30″ E.); 487 meters; coral sand and dead coral; December 16, 1899 [A. H. Clark, 1912, 1916, 1918, 1929; Gislén, 1927, 1934] (2, U.S.N.M., E. 457; Amsterdam Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 3; 245 meters; sand; March 31, 1922 (7, U.S.N.M., E. 3203; C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 8; 300 meters; April 5, 1922 (3, C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 12; 320 meters; sand; April 9, 1922 (5, U.S.N.M., E. 3198; C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 56; 245 meters; May 10, 1922 (2, U.S.N.M., E. 3167; C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 58; 290 meters; May 12, 1922 (5, U.S.N.M., E. 3165; C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 59; 385 meters; coral; May 12, 1922 (9, U.S.N.M., E. 3153; C. M.).

Siboga station 254; East Arafura Sea, west of Taam Island (lat. 5°40′ S., long 132°26′ E.); 310 meters; fine gray mud; December 10, 1899 [A. H. Clark, 1916, 1918; Gislén, 1934] (1, U.S.N.M., E. 435).

Siboga station 294; East Timor Sea (lat. 10°12′12″ S., long. 124°27′18″ E.); 73 meters; soft mud with very fine sand; January 23, 1900 [A. H. Clark, 1916, 1918] (1, Amsterdam Mus.).

South of the Nicobar Islands; 1,023 meters; cable repair ship *Patrol*, Eastern and Associated Telegraph Co. [A. H. Clark, 1929] (2, B. M.).

Geographical range.—From northern Celebes southward to the Kei Islands, the East Arafura Sea, and the East Timor Sea, and westward to the Nicobar Islands.

History.—*Pachylometra crassa* was originally described in 1912 from a specimen from *Siboga* station 259. On the establishment of the genus *Perissometra* in 1916 *crassa* was transferred to it, and in the list of included species *Perissometra gorgonia*, a *nomen nudum*, was given. In my memoir on the unstalked crinoids of the *Siboga*

Expedition published in 1918 *Perissometra crassa* was redescribed and figured, and *P. gorgonia* was described on the basis of a specimen from station 294, notes being given on another from station 254. In the key to the species of *Perissometra*, *gorgonia* was placed in the section including species with 14–20 (usually 20) arms, while *crassa* was placed in the section including species with not more than 13 arms, and was said to have 10 or 11 stout arms; *gorgonia* was said to have the brachials with prominent swollen and produced distal borders, while in *crassa* the brachials were said to have an unmodified dorsal surface; this, however, refers to the absence of median keels or tubercles, for the figure of *crassa* shows the brachials with prominent distal ends.

In 1927 Prof. Torsten Gislén wrote that *crassa* should be referred to the genus *Glyptometra*. In 1929 I published notes on two specimens tentatively referred to *Perissometra gorgonia* which had been brought up from 560 fathoms south of the Nicobar Islands by the cable repair ship *Patrol*, and in the same paper I compared *Perissometra crassa* with a new species *P. occidentalis*. In 1934 Professor Gislén listed *Perissometra crassa* among the comatulids with the *Heterometra bengalensis* type of arm division, and *P. gorgonia* among the species with the *Comanthus solaster* type of arm division.

GLYPTOMETRA INAEQUALIS (P. H. Carpenter)

[See vol. 1, pt. I, figs. 274, p. 260, 491, p. 367; pt. 2, pl. 3, figs. 986, 987, pl. 27, fig. 1168, pl. 42, figs. 1267–1269, 1273–1275, pl. 44, figs. 1291, 1298, 1299, 1302–1304.]

Antedon inaequalis von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 18, 30, 31, 55, 70, 73 (*Challenger* stations 170, 174; myzostomes; *nomen nudum*).—P. H. Carpenter, *Challenger* Reports, Zool., vol. 11, pt. 32, 1884, p. 83, pl. 54, fig. 8 (ambulacral plating of a pinnule).—von Graff, *Challenger* Reports, Narrative, vol. I, pt. 1, 1885, p. 316 (myzostomes).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 244 (description; *Challenger* stations 170A, 174, B, C, or D, 175), pl. 2, figs. 5, *a-d;* pl. 51, fig. 2; text fig. 5A, p. 246.—Braun, Centralbl. Bakteriol. Parasitenkunde, vol. 3, 1888, pp. 185, 210 (myzostomes; after von Graff).—Hutton, Index faunae Novae Zealandiae, 1904, p. 290 (listed).—Minckert, Arch. Naturg., Jahrg. 71, 1905, vol. 1, Heft 1, p. 224 (regeneration).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1582 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 35 (identity).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, pp. 285, 306 (in *Granulifera* group; believed a synonym of *granulifera*), pp. 289, 298 (description; discussion), fig. 2, p. 288, fig. 3*b*, p. 291, figs. 7, *a–d*, p. 297.

Antedon inequalis Springer, Mem. Mus. Comp. Zool., vol. 25, No. 1, 1901, p. 45 (tegminal plates).

Charitometra inaequalis A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed); Smithsonian Misc. Coll., vol. 52. No. 2, 1908, p. 227 (compared with *Ch. smithi* [*distincta*]).

Pachylometra inaequalis A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 21 (listed); Crinoids of the Indian Ocean, 1912, p. 35 (identity), p. 216 (synonymy; localities); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 48 (published reference to specimens in the B. M.; *Challenger* stations 170, 174, 175); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 184 (in key; range; references).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8, No. 39 (notes); Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 482; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp 21, 26.

Diagnostic features.—The cirri are stout with about 20 segments of which all but the basal are subequal, about as long as broad or somewhat broader than long, and are arranged in 10 or 15 columns on the centrodorsal; the division series and arms are smooth; and the 11–20 arms are 100–145 mm. long.

Description.—The centrodorsal is hemispherical, rather flattened at the dorsal pole. Carpenter's figure shows the cirri arranged in 3 closely crowded columns of 1 or 2 each in each radial area.

The cirri are XX–XXV, about 20. According to Carpenter a few of the segments are longer than broad and the later ones are somewhat compressed laterally and more or less distinctly carinate dorsally. In the figure the segments beyond the basal are about as long as broad except for the last two which are somewhat longer.

The radials are partially visible above the interradial angles of the centrodorsal. The IBr_1 are short, sharply convex, and very closely united laterally. The IBr_2 (axillaries) are short, broadly pentagonal, and very convex in the center; a synarthrial tubercle is present. The IIBr series are 4(3+4). The elements of the IIBr series and in a lesser degree also those of the IBr series and the fourth brachial are in close lateral contact and very distinctly wall-sided with sharp edges and the margin of the dorsal surface a little depressed. The third and occasionally also the fourth brachial may likewise be slightly flattened on both the outer and inner sides. One specimen has one IIIBr 2(1+2) and one IIIBr 3(2+3) series.

The 11–20 arms are about 100 mm. long and are composed of about 120 brachials of which the lowest are nearly oblong, those following triangular and as long as broad, the succeeding becoming more wedge-shaped. The lower parts of the arms and the division series often have somewhat prominent edges.

On arms arising from a IBr axillary the first syzygy is between brachials 3+4 and the next is from between brachials 5+6 to between brachials 14+15. On arms arising from a IIBr axillary the first syzygy is usually between brachials 1+2 and the second is from between brachials 8+9 to between brachials 11+12. The distal intersyzygial interval is from 3 to 16, usually from 5 to 8, muscular articulations.

P_D is small, 7 mm. long with 20–25 short segments the lowest of which, and especially, the first, are broad, trihedral, and flattened against the arm, the remainder being slightly carinate. P_1 is a trifle longer with relatively long terminal segments and less broad and more carinate basal segments. P_2 and the following pinnules are still longer and stouter, 12 mm. in length, with the outer edges of the third and two to four following segments much produced toward the ventral side so as to give them a broad and flattened appearance. After P_3 the length of the pinnules decreases somewhat, but the expansion of their lower segments is traceable until P_{15} or P_{20}, after which they become more slender with only the two basal segments broader than long.

The disk is 10 mm. in diameter, much incised and completely plated both along the ambulacra and at the sides. A pavement of anambulacral plates covers the gonads. The pinnule ambulacra have well defined side plates alternating with and partly concealing the sacculi, which are mostly small.

The color in alcohol is light whitish brown.

Notes.—After examining the *Challenger* specimens in the British Museum Gislén wrote that in this species there are often syzygies between brachials 1+2 and 3+4, in other words that the first four brachials are often united in two syzygial pairs. He gives a diagram of the conditions in a postradial series with two IIBr 4(3+4) series. One of these gives rise to two arms on one of which the syzygies are between brachials 1+2 and 10+11, while on the other they are between brachials 1+2 and 11+12. On the other IIBr series the inner branch is undivided with syzygies between brachials 1+2, 4+5, 11+12, and 17+18. The outer branch is a IIIBr 3(2+3) series with the inner arm having syzygies between brachials 1+2, 4+5, 11+12, 17+18, while the outer arm has them between brachials 1+2, 8+9, 14+15, and 20+21.

Carpenter said that the number of arms in this species varies very considerably. Several individuals have 20, but 14 to 16 is not an uncommon number, and two specimens have only 11. IIIBr series occur in two specimens. In one the IIIBr series is 2(1+2) and in the other it is 3(2+3).

The *Albatross* specimen from the Philippines, which is clinging to part of a stem of *Saracrinus acutus*, has 20 arms 145 mm. long; of the ten IIBr series eight are 4(3+4) and two are 2. The cirri are XXV, 22–23, with all the segments except the basal about as long as broad.

Localities.—*Challenger* station 170A; near Kermadec Islands (lat. 29°45′ S., long. 178°11′ W.); 1,152 meters; bottom temperature 4.17° C.; volcanic mud; July 14, 1874 [von Graff, 1884, 1885; P. H. Carpenter, 1884, 1888; Braun, 1888; Springer, 1901; Hutton, 1904; Minckert, 1905; Hamann, 1907; A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1918; Hartlaub, 1912; Gislén, 1928, 1934] (3, B. M.).

Challenger station 174 (B, C, or D); near Kandavu, Fiji (lat. about 19°06′ S., long. about 178°18′ E.); 466, 1,115, or 384 meters; bottom temperature (at 1,115 meters) 3.89° C.; coral mud; August 3, 1874 [von Graff, 1884, 1885; P. H. Carpenter, 1884, 1888; Braun, 1888; Springer, 1901; Minckert, 1905; Hamann, 1907; A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1918; Hartlaub, 1912; Gislén, 1928, 1934] (3, M. C. Z., 268; B. M.).

Philippine Islands; *Albatross* (1, U.S.N.M., 35896).

Doubtful locality.—*Challenger* station 175; near Kandavu, Fiji (lat. 19°02′ S., long. 177°10′ E.); 2,468 meters; bottom temperature 2.22° C.; globigerina ooze; August 12, 1874 [von Graff, 1884, 1885; P. H. Carpenter, 1884, 1888; Braun, 1888; Springer, 1901; Minckert, 1905; Hamann, 1907, A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1918; Hartlaub, 1912; Gislén, 1928, 1934] (1, B.M.).

Geographical range.—From the Philippine Islands to Fiji and the Kermadec Islands, north of New Zealand.

Bathymetrical range.—One definite and reliable record, 1,152 meters.

Thermal range.—One definite record, 4.17° C.

History.—*Antedon inaequalis* was first mentioned by Prof. Ludwig von Graff in his memoir on the myzostomes of the *Challenger* Expedition published in 1884. The name as given by him was a *nomen nudum*. In his report on the stalked crinoids of the *Siboga* Expedition published in 1884 Dr. P. H. Carpenter cited *Antedon* (*Poecilometra*) *acoela* and *A. inaequalis*, both from station where pentacrinites were abundant, as good examples of comatulids with the pinnule ambulacra as fully as well or even better plated than those of the pentacrinites. He gave a so-called specific formula for *Antedon inaequalis*, which technically is the equivalent of a description, and figured the ambulacral skeleton of a pinnule. In 1885 Professor von Graff again listed *Antedon inaequalis*, and in his report on the comatulids of the *Challenger* Expedition Dr. Carpenter in 1888 described and figured it in detail, listing 12 specimens from station 170A, 5 from station 174 (B, C, or D), and one broken specimen from station 175, a locality he regarded as doubtful.

Braun in 1888 cited *Antedon inaequalis* as a host for certain myzostomes; Springer in his study of *Uintacrinus* published in 1901 mentioned the tegminal plates; Hutton in 1904 listed it as a New Zealand species; Minckert in 1905 discussed the arrangement of the syzygies; and it was listed by Hamann in 1907.

In my first revision of the old genus *Antedon* published in 1907 *Antedon inaequalis* was transferred to the new genus *Charitometra*, and in 1908 I compared *Charitometra inaequalis* with a new species, *Ch. smithi*. On the establishment of the genus *Pachylometra* in 1909 *inaequalis* was transferred to it. In my memoir on the crinoids of the Indian Ocean published in 1912 *Pachylometra inaequalis* was listed and the range and synonymy were given, and in 1913 I gave notes on the *Challenger* specimens I had examined at the British Museum—two from station 174, one from station 175, and three from station 170. In 1918 in my report on the unstalked crinoids of the *Siboga* Expedition *inaequalis* was included in the key to the species of *Pachylometra* and the synonymy and range were given. In 1928 Prof. Torsten Gislén published additional notes on the specimens in the British Museum, and in 1934 he listed *Pachylometra inaequalis* among those comatulids with the *Perissometra macilenta* type of arm division, and also among those with the *Crossometra septentrionalis* type of arm branching.

GLYPTOMETRA SEPTENTRIONALIS (A. H. Clark)

[See vol. 1, pt. 1, fig. 369, p. 299; pt. 2, fig. 675, p. 335.]

Charitometra distincta A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 312 (Sagami Bay).

Pachylometra septentrionalis A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 554 (description, based upon the preceding); Proc. Biol. Soc. Washington, vol. 25, 1912, p. 78 (compared with *P. helius*); Crinoids of the Indian Ocean, 1912, p. 215 (synonymy; locality); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance).

Crossometra septentrionalis A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 606 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. ix (relationship with *C. helius*), p. 175 (in key; range), p. 176 (references).—Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 119 (Bock's station 36; notes), figs. 77, 78, p. 88; Zool. Bidrag Uppsala, vol. 9, 1924, pp. 44, 71, 80, fig. 80, p. 81 (syzygial face), fig. 109, p. 93 (synarthrial face); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 26.

Crossometra distincta Gislén, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 120.

Diagnostic features.—The proximal portion of the animal is very broad, the profile of the division series and arm bases being strongly convex; the ossicles of the division series and first two brachials each bear a more or less developed low rounded tubercle; the distal cirrus segments are broader than long and bear dorsally a high narrow sharp keel the crest of which is parallel to the longitudinal axes of the segments; the 33 arms are 130 mm. long; and the cirri have 19–23 segments.

Description.—The centrodorsal is very rounded conical, broader at the base than high, with the bare polar area very small, 1 mm. in diameter, and surrounded by 5 small radial tubercles. The cirrus sockets are arranged in 10 closely crowded columns of 2 or 3 each.

The cirri are XX, 19–23, about 35 mm. long, very stout, and in lateral view increasing considerably in width in the outer portion. The first segment is short, twice as broad as long, and the following gradually increase in length to the fourth which is about as long as broad. The succeeding segments are similar to the fourth, the terminal becoming slightly broader than long. The penultimate segment is of less width than those immediately preceding, and is half again as long as broad. On the fourth or fifth segment the dorsal surface becomes rounded carinate, this carination slowly becoming higher and sharper, on the distalmost 10 or 12 standing out as a high narrow sharp keel the distal portion of the profile of the crest of which in lateral view is seen to be parallel to the longitudinal axes of the segments. The opposing spine is small, but prominent, and terminal in position.

The ends of the basal rays are very prominent in the interradial angles of the calyx.

The radials are concealed by the centrodorsal. The IBr_1 are very short, crescentic, the lateral edges thickened and more or less everted, and the proximal edge thickened and more or less tubercular or crenulate; a rather high, strongly rounded, dorsoventrally elongate tubercle occupies the median dorsal line. The IBr_2 (axillaries) are triangular, twice as broad as long, with a high median tubercle resembling that on the IBr_1 the distal portion of which bends to one side or the other reaching almost or quite to the base of the $IIBr_1$. Of the 10 IIBr series present 9 are 4(3+4) and one is 2. They are strongly and evenly convex dorsally. The 2 distal elements are slightly separated interradially by the carinate basal segments of P_D. The ossicles of the IIBr series bear rounded median tubercles similar to those on the IBr series, but somewhat less high. The IIIBr series are 2(1+2), developed internally in 1, 2, 2, 1 order. Two IVBr series are present, both 2(1+2), one internal in reference to the preceding IIIBr series, the other internal in reference to the preceding IIBr series. The lower part of the animal is broad and stout and broadly rounded so that the profile resembles in general that of the larger species of *Crinometra*.

The 33 arms are 130 mm. long. The proximal oblong brachials have a slight trace of a low median tubercle, and the outer brachials overlap slightly.

Notes.—Professor Gislén says that in the single specimen from Bock's station 36 the centrodorsal is rounded conical, the free dorsal pole without tubercles, 3 mm. broad at the base and 1.5 mm. high. The cirrus sockets are arranged in a single or double row, and in 10 columns.

The cirri are XIX, 14–16, from 14–17 mm. long, and are very stout. The fifth segment is the longest, half again as long as broad. From the eighth segment onward there is a dorsal longitudinal crest. The ventral margin of the distal segments is about as long as the width. The opposing spine is in height equal to one-third the width of the segment. The terminal claw is curved and somewhat longer that the preceding segment.

The basals project as large interradial prominences.

The radials are eight times as broad as long and bear a median tubercle. The IBr_1 are five times as broad as long and are laterally united. The IBr_2 (axillaries) are three times as broad as long. There is a median tubercle on the IBr_1 and on the proximal portion of the IBr_2, and similar tubercles on the ossicles of the IIBr series. The IIBr series are 4(3+4). The IIIBr series are 2, developed internally. The elements of the IIIBr series and the first two brachials have slight median tubercles. The first segments following each axillary are united internally.

The 18+ arms are 70 mm. long. The first 12 brachials are discoidal, those following wedge-shaped. The distal brachials have a low dorsal spine which does not overlap that on the brachial succeeding. The brachials are sharply flattened laterally as far as the twelfth. The bases of the P_D are visible between the arm bases.

The first syzygy on the inner side is usually between brachials 1+2; the distal intersyzygial interval is 4 oblique muscular articulations.

P_D is about 5 mm. long with 22 segments which are thickened and bear dorsal prominences similar to those found in the family Calometridae. The first segment is twice as broad as long; the seventh and following segments are more slender and are a little flattened. The distal segments are about as long as, or a little longer than, broad.

P_1 is 4 mm. long with about 18 segments. P_2 is 3.2 mm. long with 14 segments. The distal pinnules are 4.5 mm. long with 13–14 segments of which the first two and the last two are short, the others from two to two and one-half times as long as broad.

The disk is 4 mm. in diameter, not completely regenerated, very closely and coarsely granulated, shrunken, and somewhat incised.

The color in alcohol is white, the disk dark brown.

Professor Gislén identified this specimen as a young individual of *Crossometra septentrionalis*.

Localities.—Sagami Bay, Japan; Alan Owston, yacht *Golden Hind* [A. H. Clark, 1908, 1911, 1912, 1915, 1916, 1918] (1, U.S.N.M., 27502).

Dr. Sixten Bock's Expedition to Japan 1914, station 36; Misaki, Sagami Bay, Japan; directly off shore; 366 meters; July 1, 1914 [Gislén, 1922, 1924, 1934].

History.—The first known specimen of this species was found in a collection of Japanese crinoids dredged by Alan Owston, of Yokohama, in his yacht the *Golden Hind* and subsequently purchased by Frank Springer, who presented it to the National Museum. It was recorded in 1908 under the name of *Charitometra distincta* (P. H. Carpenter). The original label had been lost, so the locality was given simply as "Sagami Bay."

The receipt of several specimens of true *distincta* from the Philippines showed that the Japanese specimen represented a wholly different species, so in 1911 it was described under the name of *Pachylometra septentrionalis*. In 1912 *P. septentrionalis* was compared with the new species *P. helius*, and in my memoir on the crinoids of the Indian Ocean published later in the same year it was listed and the synonymy and range were given. In 1915 it was listed as a southern Japanese species with the locality. On the establishment of the genus *Crossometra* in 1916 *septentrionalis* was transferred to it. In my memoir on the unstalked crinoids of the *Siboga* Expedition *septentrionalis* was included in the key to the species of *Crossometra*, the locality was given, and it was compared with *C. helius*.

Prof. Torsten Gislén in 1922 recorded and gave notes on a second specimen that had been dredged off Misaki in 200 fathoms by Dr. Sixten Bock. He added: "Though the species-name *Cr. distincta* is older still, in conformity with A. H. Clark, I do not wish to use it, partly because it is a *nomen nudum*, partly because the name *distincta* was given by P. H. Carpenter to a species in the closely-related genus *Pachylometra* (Clark did not separate this genus from *Crossometra* before 1918)."

In my first reference to this species in 1908 the specific name *distincta* was credited to Carpenter, and was not a *nomen nudum*. Gislén's slip is probably explained by his inability to understand how I ever could have identified a specimen of *septentrionalis* with a species as widely different as Carpenter's *distincta*.

In 1924 Gislén described and figured various details of the arm structure of his specimen, and in 1934 he discussed the significance of the arm branching of the species.

GLYPTOMETRA DISTINCTA (P. H. Carpenter)

PLATE 23, FIGURES 70–72; PLATE 24, FIGURE 73

[See also vol. 1, pt. 2, figs. 227, p. 183, 245, p. 199, 529, 530, p. 287, 672, p. 335, 760, p. 353, 817, 818, p. 385, 819, p. 392, 831–834, p. 405, 856, p. 412.]

Antedon distincta P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 247 (description; *Challenger* station 210), pl. 51, fig. 1.—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1582 (listed).—A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 35 (identity).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, pp. 285, 306 (in *Granulifera* group; believed synonym of *granulifera*).

Charitometra distincta A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed).—A. H. CLARK, Smithsonian Misc. Coll., vol. 52, No. 2, 1908, p. 227 (compared with *Ch. smithi*).

Charitometra smithi A. H. CLARK, Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, p. 227 (description; *Albatross* station 5123; also stations 5116, 5198); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 184, footnote, p. 185 (synonym of *distincta*).

Pachylometra distincta A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 21 (listed); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 554 (comparison with *P.* [*Crossometra*] *septentrionalis*), p. 555 (*Albatross* stations 5510, 5536; characters); Crinoids of the Indian Ocean, 1912, p. 35 (identity), p. 216 (synonymy; localities); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 48 (published reference to specimen in the B. M.; *Challenger* station 210); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 184 (in key; range), p. 185 (synonymy); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, pl. 2, fig. 29 (side plates), figs. 30, 31 (side and covering plates).—GISLÉN, Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 482; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 21, 26.

Pachylometra smithi A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 21 (listed); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 557 (*Albatross* stations 5282, 5348; correction of dimensions given in the original description); Crinoids of the Indian Ocean, 1912, p. 220 (synonymy; range).

Pachylometra selene A. H. CLARK, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 556 (description; *Albatross* station 5523; compared with *P. investigatoris*); Crinoids of the Indian Ocean, 1912, p. 219 (synonymy; locality).

Perissometra selene A. H. CLARK, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 177 (in key; range), p. 179 (references).—GISLÉN, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 22.

Crossometra distincta GISLÉN, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8, No. 34 (notes).

Diagnostic features.—The cirri have 17–26 (usually about 20) segments and are 20–30 (usually 20–25) mm. long; the earlier segments are markedly longer than broad and the distal are broader than long; the cirrus sockets are arranged in 10 columns on the centrodorsal; the 14–33 (usually 20–25) arms are 100–205 mm. long; the IIBr series are all or mostly 4(3+4); and the division series and arm bases are smooth.

Description—As described by Carpenter the centrodorsal is a thick disk with the interradial angles somewhat produced. The cirri, as determined by Gislén from an examination of the type specimen in the British Museum, are arranged in 10 columns, 2 in each radial area.

The cirri are about XXV, about 20. The sixth and seventh segments are the longest, according to the figure from slightly longer than broad to half again as long as broad. The segments following are shorter and gradually develop a dorsal keel, and according to the figure a slight tubercle in the middle of the dorsal side of the distal end.

The radials are concealed. The IBr_1 are short and much curved, and the IBr_2 (axillaries) are subtriangular, both ossicles being very convex with a rather sharp dorsal ridge. The IIBr series are 4(3+4), with the first two ossicles very convex at their junction. The IIIBr series, when present, are 2(1+2). The elements of the IBr series and the first two elements of the IIBr series are in close lateral contact with sharp lateral edges and flattened sides. In the middle of the postradial series this feature is continued on to the IIBr axillary and the first five or six brachials, but on the outer sides the IIBr axillaries are prevented from meeting those of adjacent postradial series by the pinnule of the $IIBr_2$, which is placed very near the dorsal surface.

The 27 arms of the type specimen are 100 mm. long. The first twelve brachials are nearly oblong, and those following are more triangular, gradually becoming longer than broad.

Syzygies occur between brachials 1+2, and again between about brachials 26+27. The distal intersyzygial interval is from 6 to 15, usually from 8 to 11, oblique muscular articulations.

P_D is rather slender, about 8 mm. long with about 30 small, compressed, and slightly carinate segments. The pinnules following are similar, decreasing slightly in size to about P_3 after which the next eight or ten pinnules on each side have the lower segments carinate and expanded on the outer side, with the outer ones more styliform. This feature gradually dies out, and the pinnules become more slender and elongated.

The disk and brachial ambulacra are well plated. The pinnule ambulacra have well defined side plates which alternate with the sacculi.

The color in alcohol is light whitish brown with patches of brownish gray.

Notes.—After examining the type specimen in the British Museum I wrote that it resembles those in the National Museum from the Philippines. After studying the same specimen Gislén decided that *distincta,* assigned by me to the genus *Pachylometra,* must be referred to *Crossometra* as it has the cirri arranged in 10 columns.

In 1908 I described *Charitometra smithi* from a specimen from *Albatross* station 5123 in the following terms.

The centrodorsal is thick discoidal or short columnar with the cirrus sockets arranged in 2 rows and roughly in 3 irregular columns in each radial area, though the middle column is sometimes lacking.

The cirri are XXVII–XXX, 19–22 (usually 20), 20–25 mm. long. The first segment is very short, the second is about twice as broad as long, the third is about as long as broad, the fourth is slightly longer than broad, and the fifth is nearly half again as long as broad. The following segments decrease very gradually in length, the tenth and following being about as long as their distal width. The segments after the eighth or ninth become rounded carinate dorsally, soon developing rather prominent rounded tubercles situated on the dorsal distal edge. The opposing spine, though prominent, is small, terminally situated, reaching a height equal to about half the width of the penultimate segment or rather less, its base occupying only the distal third of the segment. The terminal claw is about as long as the penultimate segment, rather stout and moderately curved.

The ends of the basal rays are just visible as more or less irregular tubercles in the angles of the calyx.

The radials are concealed in the median line of the arm, though sometimes slightly visible over the ends of the basal rays. The IBr_1 are very short, three or four times as broad as long, chevron-shaped, laterally in close apposition, and with the dorsal surface coarsely rugose. The IBr_2 (axillaries) are triangular, rather more than twice as broad as long, with the dorsal surface rugose. The IIBr series are 4(3+4), rarely 2. The IIIBr series are 2(1+2), as a rule developed interiorly in 1, 2, 2, 1 order. The IBr_1 is more or less covered with small crowded tubercles, but the remaining ossicles of the division series are perfectly smooth. The division series and proximal six or eight brachials are in close apposition and sharply flattened laterally.

The 28 arms of the type are 160 mm. long. The proximal twelve or fourteen brachials are oblong, about twice as broad as long, those following becoming triangular and nearly as long as broad, and in the distal part of the arm wedge-shaped and longer than broad.

The first syzygy is usually between brachials 1+2, but may be between brachials 3+4, especially in arms arising directly from a IIBr axillary. On arms in which brachials 1+2 are united by syzygy there is often a syzygy between brachials 3+4. The next syzygy is near brachials 19+20 to brachials 25+26 (usually between brachials 20+21 or a few segments further on), and the distal intersyzygial interval is from 4 to 12 (usually 6 or 7) oblique muscular articulations.

P_D is slender and evenly tapering, becoming flagellate distally, 13 mm. long with about 45 segments of which those in the proximal half are about half again as broad as long and those in the distal about as long as broad. P_1 is similar but only about 9 mm. long with 35 segments the first five of which are noticeably carinate. P_2 is of about the same length but consists of only about 25 segments the first four or five of which are carinate and slightly broader than those of P_1; the terminal segments are about twice as long as broad. In the pinnules following the segments, except the first two, gradually become longer and fewer in number. P_{10} is 8 mm. long with 17 segments of which the first two are not so long as broad and bear a triangular or bluntly triangular process distally and the remainder are about as long as broad, gradually becoming slightly longer than broad; the third to seventh or eighth segments are very slightly enlarged, protecting the gonads, but the enlargement is not very noticeable and tapers evenly in both directions. The distal pinnules are 9 mm. long with 17–18 segments of which the first is short and wedge-shaped, the second is not quite so long as broad, and the remainder are about half again as long as broad.

In alcohol the arms and cirri are yellow, the calyx, division series, and first four or five brachials dark brown.

In 1916 I described a specimen from *Albatross* station 5523 under the name of *Perissometra selene* in the following terms.

The centrodorsal resembles that of *G. investigatoris.*

The cirri are XXX, 17–19, from 25 to 30 mm. long, much shorter and with fewer segments than those of *G. investigatoris.* The segments in the outer half have rather strongly produced distal dorsal edges which bear a rounded tubercle in the median line so that the dorsal profile of the cirri is strongly serrate.

The division series and arm bases diverge, as in *G. investigatoris,* and are only slightly convex dorsally, not so much so even as in that species; each ossicle is smooth and even dorsally, but bears in its center a very prominent high rounded tubercle; these tubercles gradually become obsolete after the proximal quarter of the arms, but may be traced as far as the beginning of the distal half. Two of the IIBr series are 4(3+4) and two are 2. There are no IIIBr series present.

The 14 arms are 205 mm. long.

Another specimen from *Albatross* station 5523 has 20 arms 195 mm. long. Of the ten IIBr series nine are 4(3+4) and one is 2. The cirri are XXX, 17–21 (usually 18–19). The tubercles on the division series and lower brachials are not quite so prominent as in the type specimen.

Of the four specimens from *Albatross* station 5510 one has 21 arms 130 mm. long and the cirri 20–25 mm. long; another has 29 arms with the IIIBr series 2(1+2), internally developed; a third has 24 arms.

The single fine specimen from *Albatross* station 5536 has 23 arms 160 mm. long and the cirri XXVI, 19–24, 23–25 mm. long; all the IIBr series are 4(3+4); the three IIIBr series are 2(1+2), developed internally. The genital pinnules bear eggs.

From *Albatross* station 5348 there are 22 medium sized or small specimens with 19–22 arms which in the larger are from 125 to 135 mm. long.

Of the three specimens from *Albatross* station 5282 one has 25 arms 150 mm. long; another has 30 arms 140 mm. long, one IIBr series dividing both internally and externally and another not dividing at all; and the third has 33 arms 110 mm. long, three of the internally developed IIIBr series bearing on the innermost side IVBr 2(1+2) series.

The specimen from Menado Bay, Celebes, is small with apparently 20 arms; of the ten IIBr series nine are 4(3+4) and one is 2.

The specimen from the Danish Expedition to the Kei Islands station 51 has 19 arms 130 mm. long; of the IIBr series five are 4(3+4) and four are 2.

The specimen from the Danish Expedition to the Kei Islands station 52 has 20 arms 140 mm. long. Of the IIBr series five are 4(3+4) and five are 2. The cirri have 20–26 (usually 20–23) segments.

Localities.—*Albatross* station 5282; China Sea in the vicinity of southern Luzon; Malavatuan Island (N.) bearing S. 84° W., 6.20 miles distant (lat. 13°53′00″ N., long. 120°26′45″ E.); 453 meters; bottom temperature 8.55° C.; dark gray sand; July 18, 1908 [A. H. Clark, 1911] (2, U.S.N.M., 35720).

Albatross station 5116; Verde Island Passage; Sombrero Island bearing N. 69° E., 2.50 miles distant (lat. 13°41′00″ N., long. 120°47′05″ E.); 366 meters; bottom temperature 10.11° C.; January 20, 1908 [A. H. Clark, 1908] (14, U.S.N.M., 35721).

Albatross station 5123; east coast of Mindoro; Malabrigo Light bearing N. 44° W., 32.50 miles distant (lat. 12°12′45″ N., long. 121°38′45″ E.); 517 meters; green mud; February 2, 1908 [A. H. Clark, 1908, 1909, 1911, 1912] (1, U.S.N.M., 25448 [type]).

Albatross station 5348; Palawan Passage; Point Tabonan bearing S. 89° E., 33.5 miles distant (lat. 10°57′45″ N., long. 118°38′15″ E.); 685 meters; bottom temperature 13.44° C.; coral sand; December 27, 1908 [A. H. Clark, 1911] (20, U.S.N.M., 35681).

Albatross station 5198; in the vicinity of western Bohol; Baliscasag Island bearing S. 6° E., 10.25 miles distant (lat. 9°40′50″ N., long. 123°39′45″ E.); 402 meters; bottom temperature 12.17° C.; green mud; April 9, 1908 [A. H. Clark, 1908] (1, U.S.N.M., 35719).

Challenger station 210; off Panglao and Siquijor Islands (lat. 9°26′ N., long. 123°45′ E.); 685 meters; bottom temperature 12.26° C.; blue mud; January 25, 1875 [P. H. Carpenter, 1888; Hamann, 1907; A. H. Clark, 1907, 1908, 1909, 1911, 1912, 1913, 1918, 1921; Gislén, 1928, 1934; Hartlaub, 1912] (1, B. M.).

Albatross station 5536; between Negros and Siquijor; Apo Island (C.) bearing S. 26° W., 11.8 miles distant (lat. 9°15′45″ N., long. 123°22′00″ E.); 510 meters; bottom temperature 11.94° C.; green mud; August 19, 1909 [A. H. Clark, 1911] (1, U.S.N.M., 35703).

Albatross station 5523; off northern Mindanao; Point Tagolo Light bearing S. 48° W., 6.7 miles distant (lat. 8°48′44″ N., long. 123°27′35″ E.); no depth or temperature given; August 10, 1909 [A. H. Clark, 1911, 1912, 1916, 1918; Gislén, 1934] (2, U.S.N.M., 27504 [type], 36001).

Albatross station 5510; in the vicinity of northern Mindanao; Camp Overton Light bearing S. 68° E., 9.1 miles distant (lat. 8°16′00″ N., long. 124°03′50″ E.); 773 meters; bottom temperature 11.66° C.; gray mud and fine sand; August 7, 1909 [A. H. Clark, 1911] (3, U.S.N.M., 35718).

Menado Bay, northern Celebes (lat. 1°31′ N., long. 124°47′ E.); 457 meters; Captain Christiansen, Great Northern Telegraph Company, March 12, 1913 (1, C.M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 51; 348 meters; mud; May 7, 1922 (1, C.M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 52; 252 meters; mud; May 7, 1922 (1, U.S.N.M., E. 3152).

Geographical range.—From southern Luzon, Philippines, southward to the Kei Islands.

Bathymetrical range.—From 252 to 773 meters.

Thermal range.—From 8.55° to 13.44° C.; the average of seven records is 11.42° C.

History.—*Antedon distincta* was described and figured by Dr. P. Herbert Carpenter in his report on the comatulids of the *Challenger* Expedition published in 1888, on the basis of a specimen from station 210. It was listed by Dr. Otto Hamann in 1907, and in the same year in my first revision of the old genus *Antedon* it was transferred to the new genus *Charitometra*.

In 1908 I described *Charitometra smithi* from a specimen from *Albatross* station 5123, at the same time recording other specimens from stations 5116 and 5198. On the establishment of the new genus *Pachylometra* in 1909 both *distincta* and *smithi* were transferred to it. In 1911 in a paper on a collection of crinoids made by the *Albatross* in the Philippines I recorded and gave notes on four specimens of *Pachylometra distincta* from station 5510 and one, on which the genital pinnules bore eggs, from station 5536; I remarked that the most striking characteristic of this species is its slenderness, especially the slenderness of the cirri, the long proximal segments of which are twice as long as broad. I briefly described *Pachylometra selene* from a specimen from station 5523, and recorded and gave notes on 3 specimens of *Pachylometra smithi* from station 5282, 22 from station 5348, and remarked that in the original description of this species the arm length was given as 60 mm., an error for 160 mm. In my memoir on the crinoids of the Indian Ocean published in 1912 *Pachylometra distincta*, *P. smithi*, and *P. selene* were listed and their synonymies and ranges were given. In my paper on the crinoids of the British Museum published in 1913 I remarked that the type specimen of *Antedon distincta* in the *Challenger* collection resembles others in the U. S. National Museum from the Philippine Islands. On the establishment of the new genus *Perissometra* in 1916 *selene* was transferred to it. In my report on the unstalked crinoids of the *Siboga* Expedition published in 1918 *selene* was included in the key to the species of *Perissometra* and the synonymy and range were given; at the same time *distincta* was included in the key to the species of *Pachylometra*, the range and synonymy were given, and *Charitometra smithi* was included as a synonym under it. In 1921 in a popular account of the recent crinoids I figured the side plates and the side and covering plates of *Pachylometra distincta.* These figures were taken from Part 2 of the present work, figure 29 being a reproduction of figures 833 and 834, page 405, and figures 30 and 31 being reproductions of figures 832 and 831 on the same page.

After examining the type specimen of *Antedon distincta* Prof. Torsten Gislén wrote in 1928 under *Crossometra distincta* that this species which I ranged in the genus *Pachylometra* must be referred to *Crossometra* as it has the cirri arranged in 10 columns (or, as he gave it, rows). In 1934 Professor Gislén listed *Perissometra selene* among the comatulids with the *Comanthus solaster* type of arm branching, and placed *Pachylometra distincta* both among those species with the *Perissometra macilenta* type of arm division, and among those with the *Crossometra septentrionalis* type of arm division.

GLYPTOMETRA INVESTIGATORIS (A. H. Clark)

Plate 24, Figures 74, 75; Plate 25, Figures 76–78

[See also vol. 1, pt. 2, figs. 226, p. 180, 537, 538, p. 289, 673, p. 335, 867, p. 419.]

Pachylometra investigatoris A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 82 (description; Malay Archipelago; 30 fathoms); Proc. U. S. Nat. Mus., vol. 39, 1911, p. 556 (compared with *P. luna* and *P. selene*); Crinoids of the Indian Ocean, 1912, p. 216 (synonymy; detailed description; locality), fig. 39, p. 217.

Pachylometra luna A. H. Clark, Proc. U. S. Nat. Mus., vol. 39, 1911, p. 556 (description; *Albatross* station 5325; comparisons); Crinoids of the Indian Ocean, 1912, p. 219 (synonymy; locality).

Pachylometra helius A. H. Clark, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 78 (description; *Siboga* station 254).

Crossometra helius A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 606 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. ix (relationship with *C. septentrionalis*), p. 174 (in key; range), p. 175 (detailed description; references; station 254), p. 274 (listed), pl. 24, fig. 67; Treubia, vol. 14, livr. 2, December 1933, p. 207 (previous records), p. 214 (Bali Sea; notes).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 26.

Crossometra investigatoris A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 606 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 174 (in key; range), p. 175 (references; notes; station 297), p. 275 (listed).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 26.

Diagnostic features.—The cirri, which are arranged in 10 columns on the centrodorsal, have 20–31 (most commonly 22–27) segments, and are 25–47 (most commonly 30–35) mm. long; the proximal segments are longer than broad and the distal are about as long as broad or slightly broader than long; the 18–32 (most commonly 26–30) arms are 110–170 mm. long; and the division series and proximal brachials are smooth. There seems to be little real difference between this species and *G. distincta.*

Description.—The centrodorsal is a truncated cone 7 mm. broad at the base and 5 mm. high. The cirrus sockets are arranged in two columns of from 3 to 5 each in each radial area, the two columns of each area being separated by a narrow median line not quite so broad basally as the sockets, distally narrowing and ending in a point at about the level of the third or fourth cirrus socket. The columns of each radial area are closely crowded against, and tend to alternate with, the columns of the adjacent areas.

The cirri are XL, 25–26, about 40 mm. long. The first segment is very short, the second and third are equal in size, about twice as broad as long, the fourth is slightly longer, the fifth is as long as broad, and the sixth, seventh, and eighth are the longest, from slightly longer than broad to about one-third again as long as broad; those following very gradually decrease in length so that those in the distal half are about as long as broad, or in some cases slightly broader than long. The third segment from the distal end of the cirri is slightly longer than broad; the antepenultimate segment is about one-third again as long as broad; the penultimate segment, which is somewhat less in diameter than the segment preceding, is half again as long as broad. The distal dorsal edges of the outer segments show an inclination to develop low blunt tubercles. The opposing spine is represented by a small blunt tubercle, terminally situated. The terminal claw is long, about as long as the penultimate segment, and is moderately curved. The cirri are rounded in cross section proximally and moderately compressed in the distal two-thirds. There is no trace of dorsal carination.

The ends of the basal rays are visible as large rhombic tubercles in the angles of the calyx.

The radials are concealed. The IBr_1 are short, four or five times as broad as long, chevron-shaped, in close lateral apposition, and have more or less wavy proximal and distal borders; the apposed edges are somewhat thickened and produced, and there are a few low and broad tubercles on the distal border. The IBr_2 (axillaries) are rhombic, twice as broad as long, rising to a rather sharp dorsoventrally elongated tubercle with the IBr_1. The IIBr series are 4(3+4); on three of the IIBr series the syzygy between the two outer elements is replaced by a synarthry. The IIIBr series are 2(1+2), developed interiorly. The division series are strongly rounded dorsally and have a slightly indicated median carination; they are in very close lateral apposition and their lateral edges are slightly produced and everted.

The 32 arms are 150 mm. long. The first two to four brachials are oblong, short, united in syzygial pairs which are not quite so long as broad. The two or three following brachials are oblong, somewhat over twice as broad as long, those succeeding becoming wedge-shaped, twice as broad as long, and slightly longer and more oblique after the proximal third of the arm, when the brachials develop slightly prominent distal ends.

P_D is from 17 to 20 mm. long, very slender and flagellate distally, composed of 50–53 segments, of which the two first are disproportionately large, twice as broad as long, and are strongly flattened exteriorly, the third is about half as broad as the first and half as long as the second, twice as broad as long, and those following to the fifteenth decrease in diameter and increase in length, being at first twice as broad as long but becoming after the fifteenth uniformly small and about as long as broad. P_1 is of about the same length with 45 segments, similar but much less stout basally and not tapering so rapidly. P_2 is 13 mm. long with about 30 segments, about as stout basally as the preceding pinnule but tapering much more gradually; the first eight segments are about three times as broad as long, those following gradually becoming longer and about as long as broad on about the eighteenth, and terminally longer than broad.

P_3 is about 15 mm. long, and P_4 is 16 or 17 mm. long, resembling P_2. P_5 is similar, 13 mm. long. P_6 is similar and of the same length. P_7 and the following pinnules are 12 mm. long with the segments on the proximal two-thirds slightly expanded laterally. In the course of the following four or five the pinnules decrease in length to 8 mm., while the expansion of the segments becomes more pronounced, beginning on the second, reaching a maximum on the fourth or fifth, then gradually dying away distally. The distal pinnules are 10 mm. long and stout, as in the other species of the genus.

Side- and covering-plates are well developed. The disk is completely covered by a pavement of small plates.

Notes.—The specimen from *Albatross* station 5325 was described as a new species under the name *Pachylometra luna* in the following terms.

The centrodorsal is as in *P. investigatoris*, but is proportionately shorter; the cirrus sockets are arranged in 10 columns of 2 or 3 each.

The division series and arm bases are essentially as in *P. investigatoris*, but the basal rays are much larger, rhombic, entirely concealing the radials in the interradial angles of the calyx. The division series and arm bases make a slightly greater angle with the dorsoventral axis than in *G. investigatoris*, though in general the shape and proportions are the same. The division series are more convex dorsally than are those of *G. investigatoris*, and the center of each in the median dorsal line rises into a broadly rounded tubercle instead of being obscurely carinate as in *G. investigatoris*. Similarly, indistinct broad tubercles occur on the oblong proximal brachials. The interradial angles are slightly more deeply excavated than are those of *G. investigatoris*. All the IIBr series are 4(3+4) and all the IIIBr series are 2(1+2), all but a single one of the latter being developed internally.

The 29 arms of the type specimen are 150 mm. long.

One of the specimens from off Zamboanga has 27 arms 180 mm. long. All the IIBr series are 4(3+4) and there are seven IIIBr 2 series, all internally developed. The proximal profile of the division series and arm bases is broadly rounded. The centrodorsal is large, conical, with the cirrus sockets in 10 columns of 4 each. The two columns in each radial area are closely crowded against those of the adjacent radial areas and are separated in the midradial line by a bare area about the width of a cirrus socket or somewhat less. The cirri are XL, 24–27, from 45 to 50 mm. long. The first segment is very short, the third is about twice as broad as long, the sixth is about as long as broad, and the eighth and following are about one-third again as long as broad. Toward the end of the cirri the segments often become slightly shorter, but the last two are longer again, the penultimate usually half again as long as broad. The outer segments are more or less sharply carinate dorsally. This specimen is larger than the largest in the type series of *helius* from *Siboga* station 254 but does not appear to differ from them in any essential particular.

Another specimen from off Zamboanga has 29 arms 170 mm. long; there are ten IIBr 4(3+4) series and nine IIIBr 2 series, the latter all internally developed. The cirri are XXX, 23–24, up to 40 mm. long; the outer cirrus segments are more or less carinate.

A third specimen from off Zamboanga has 30 arms, ten IIIBr 2 series being present, all internally developed.

One of the specimens from Menado Bay, Celebes, is large with 22 arms; eight of the IIBr series are 4(3+4) and one is 2. There are three IIIBr 2 series, all internal. The cirri have 18–19 segments of which the longest are about as long as broad or slightly broader than long, and the outer are broader than long. The second specimen is similar. There are three IIBr 2 series, the other seven being 4(3+4). The longest cirri have 19 segments of which the longest are broader than long and the outer are from half again to twice as broad as long. The third specimen is much broken.

A specimen from *Siboga* station 254 was described as a new species under the name of *Pachylometra helius* in the following terms:

The centrodorsal is of moderate size, flattened hemispherical or thick truncated conical, 6 mm. in diameter at the base, 3 mm. across the flat dorsal pole, and 4 mm. high. The cirrus sockets are arranged in 10 evenly spaced columns of 2 or 3 each.

The cirri are about XXV, 23, about 28 mm. long. The first segment is short, those following gradually increasing in length to the fifth and sixth, which are the longest, between one-third and one-half again as long as broad. The segments following very slowly decrease in length so that those in the distal third of the cirri are about as long as the distal width. In the distal third of the cirri the median portion of the distal dorsal edge of the segments is somewhat swollen, this swelling on the last five or six before the penultimate becoming a blunt subterminal dorsal tubercle. The opposing spine is prominent, short, sharp, terminal, and directed obliquely forward.

The ends of the basal rays are visible as large rhombic tubercles in the angles of the calyx.

The radials are entirely concealed. The IBr_1 are very short, broadly V-shaped, with the proximal and distal edges parallel; the lateral thirds of the proximal and distal borders are slightly produced. The IBr_2 (axillaries) are very short, nearly or quite three times as broad as long, rhombic in shape with concave sides and truncated lateral angles, the lateral edges being about as long as those of the IBr_1. The lateral edges and all but the median portion of the proximal edge are very slightly produced. The synarthrial tubercles are low and broad, scarcely evident. The contour of the proximal portion of the animal is broadly rounded, as in *G. septentrionalis*.

The 26–28 arms are 125 mm. long and have a smooth dorsal profile. The IIBr series are 4(3+4) and the IIIBr series are 2, internally developed. The dorsal portion of the basal segments of P_D is visible between the IIBr series.

In another specimen from *Siboga* station 254 the IIIBr series are 2, internally developed except for one which is situated by the side of an internal IIIBr series. In a specimen with 28 arms eight of the IIBr series are 4(3+4) and two are 2; the cirri are from 25 to 34 mm. long with 20–23 segments. The three other specimens are small with 17, 19, and 20 arms.

The specimen from the Danish Expedition to the Kei Islands station 8 has 28 arms 150 mm. long. Three postradial series are regular with 6 arms each, there being two IIBr 4(3+4) series and two internally developed IIIBr 2 series. One postradial series has 7 arms, there being three IIBr 2 series. The IBr axillary is followed by two ossicles side by side, but these bear a single very broad ossicle with two distal angles which bears 3 arms side by side.

The specimen from the Danish Expedition to the Kei Islands station 12 has 26 arms 130 mm. long. Two of the IIBr series are 2. There are six IIIBr 2 series, all internally developed. The longest cirri are 30–35 mm. in length with 24–27 segments.

The specimen from the Danish Expedition to the Kei Islands station 28 has 25 arms about 120 mm. long. The centrodorsal is thick-discoidal, about twice as broad at the base as high. The cirrus sockets are arranged in 10 columns of 3, in two cases of 2, each. The columns are closely crowded in the interradial areas, but in the midradial lines are separated by a narrowly V-shaped deep cleft with an irregular and rugose bottom which at the margin of the centrodorsal is usually about as broad as half the width of the adjacent cirrus sockets. The peripheral cirri are all lost. The nine IIBr series present are all 4(3+4). The six IIIBr series are all 2, and all are internally developed.

The specimen from the Danish Expedition to the Kei Islands station 45 has 30 arms 120 mm. long. There are ten IIIBr 2 series, all internally developed.

The specimen from the Danish Expedition to the Kei Islands station 49 has 24 arms 140 mm. long. The longest cirri are from 32 to 35 mm. long with 26–27 segments.

The specimen from the Danish Expedition to the Kei Islands station 59 is small with 26 arms 105 mm. long.

The specimen from the Danish Expedition to the Kei Islands station 62 has 23 arms 145 mm. long; of the IIBr series six are 2, three are 4(3+4), and one is 3; of the IIIBr series two, both internally developed, are 2, and one, externally developed by the side of one of the others, is 4(3+4). The longest cirri are 43–47 mm. long with 29–31 segments.

The largest specimen from *Siboga* station 297 has 20 arms 110 mm. long; there are no IIIBr series; the cirri are 30 mm. long with 22–23 segments. Another has 21 arms. The third has 18 arms about 90 mm. long.

The specimen from the Bali Sea has 26 arms about 150 mm. long. The cirri are 30–38 mm. long and are composed of 20–22 segments.

Localities.—Albatross station 5325; off northern Luzon; Hermanos Island (N.) bearing N. 86° E., 6.75 miles distant (lat. 18°34′15″ N., long. 122°01′00″ E.); 409 meters; bottom temperature 11.77° C.; green mud; November 12, 1908 [A. H. Clark, 1911] (1, U.S.N.M., 27503).

Twenty-five miles east by south from Zamboanga, Mindanao; 292–365 meters; hard bottom; Dr. Th. Mortensen, March 3, 1914 (3, U.S.N.M., E. 3237; C. M.).

Albatross station 5617; off Ternate; Ternate (S. E.) bearing S. 45° W., 7 miles distant (lat. 0°49′30″ N., long. 127°25′30″ E.); 239 meters; November 27, 1909 (1, U.S.N.M., 36013).

Malay Archipelago; 55 meters; *Investigator* [A. H. Clark, 1909, 1911, 1912, 1916, 1918; Gislén, 1934] (1, I. M.).

Menado Bay, northern Celebes (lat. 1°31′ N., long. 124°47′ E.); 457 meters; Captain Christiansen, Great Northern Telegraph Company, March 12, 1913 (3, C. M.).

Siboga station 254; west side of Taam Island (lat. 5°40′ S., long. 132°26′ E.); 310 meters; fine gray mud; December 10, 1899 [A. H. Clark, 1912, 1916, 1918; Gislén, 1934] (5, U.S.N.M., E. 471; Amsterdam Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 8; about 300 meters; mud; May 5, 1922 (1, U.S.N.M., E. 3199).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 12; 320 meters; sand; April 9, 1922 (1, C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 28; 400 meters; mud; April 17, 1922 (1, C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 45; 270 meters; sand; May 1, 1922 (1, C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 49; 245 meters; sand; May 3, 1922 (1, C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 59; 385 meters; coral; May 12, 1922 (1, U.S.N.M., E. 3154).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 62; 290 meters; sand and shells; May 15, 1922 (1, C.M.).

Siboga station 297; Timor Sea (lat. 10°39′ S., long. 123°40′ E.); 520 meters; soft gray mud with a brown upper layer; January 27, 1900 [A. H. Clark, 1918] (3, U.S.N.M., E. 478; Amsterdam Mus.).

Bali Sea (lat. 7°35′ S., long. 114°42′ E.); about 200 meters; Dr. Th. Mortensen's South Africa-Java Expedition 1929–30; April 10, 1929 [A. H. Clark, 1933] (1, Buitenzorg Mus.).

Geographical range.—From northern Luzon southward to the Kei Islands and Timor and westward to Java.

Bathymetrical range.—From 55 to 520 meters; there is a possibility of error in the first figure; the next shallowest depth recorded is about 200 meters.

Thermal range.—One record, 11.77° C.

History.—*Pachylometra investigatoris* was first described in 1909 from a specimen dredged by the Royal Indian Marine Survey Steamer *Investigator* in the Malay Archipelago in 30 fathoms. In 1911 it was again described under the name of *Pachylometra luna* on the basis of a specimen from *Albatross* station 5325. In 1912 I described *Pachylometra helius* from a specimen from *Siboga* station 254. Later in the same year in my memoir on the crinoids of the Indian Ocean I redescribed and figured *Pachylometra investigatoris* and listed *P. luna* giving the original reference and the range. On the establishment of the genus *Crossometra* in 1916 *Pachylometra investigatoris* was selected as the genotype, and *P. helius* was included in it. In my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 *Crossometra helius* was redescribed and figured, and three specimens of *C. investigatoris* were recorded from station 297 with notes; *Pachylometra luna* was included as a synonym under *C. investigatoris*. In 1933 I recorded and gave notes on a specimen of *Crossometra helius* from the Bali Sea.

In 1934 Prof. Torsten Gislén recognized a special type of crinoid arm branching which he called the *Crossometra septentrionalis* type, including in it *Crossometra helius* and *C. investigatoris*.

GLYPTOMETRA MACILENTA (A. H. Clark)

PLATE 26, FIGURES 79–81

[See also vol. 1, pt. 2, figs. 533, 534, p. 287, 670, p. 335.]

Pachylometra macilenta A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 81 (description; 10°47′45″ N., 72°40′20″ E.; 705 fathoms), p. 149 (compared with *P. invenusta*); Crinoids of the Indian Ocean, 1912, p. 222 (synonymy; detailed description; locality), fig. 41, p. 223.

Perissometra macilenta A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 178 (in key; range), p. 181 (references); Journ. Linn. Soc. (Zool.), vol 36, No. 249, April 1919, p. 658 (south of Timorlaut; 500 fathoms; notes).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 21.

Perissometra occidentalis A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 635 (listed), p. 655 (120 miles off the Seychelles, 800 fathoms; description), pl. 42, fig. 10; John Murray Exped., 1933–34, Sci. Reports, vol. 4, No. 4, Crinoids, 1936, 1937, p. 101 (range), p. 104.

Diagnostic features.—The cirri, which are arranged in 10 columns on the centrodorsal, are comparatively long and slender, 25–36 mm. long with 15–22 segments of which the earlier are from one-third to half again as long as broad and the distal are about as long as broad; the 13–15 arms are 130–170 mm. long; and the division series and arm bases are rugose.

Description.—The centrodorsal is a short truncated cone, moderately large, with the bare dorsal pole flat and 2.5 mm. in diameter. The cirrus sockets are arranged in 10 columns of usually 2 each, the columns of adjacent radial areas closely crowded and more or less alternating, the two within the same radial area usually slightly separated proximally.

The cirri are XX, 21–22, from 25 to 36 mm. long, comparatively long and slender. The first segment is very short, the second is twice as broad as long, the third is about as long as broad, and those following gradually increase in length to the sixth, which is about half again as long as broad. The next two or three segments are similar, those succeeding very gradually decreasing in length so that the segments in the terminal third of the cirri are about as long as broad. The antepenultimate segment is about one-third again as long as broad, and the penultimate segment is half again as long as broad and is slightly less in diameter than the preceding. The opposing spine is very small, though prominent; it is terminally situated and directed obliquely forward. The terminal claw is about as long as the penultimate segment, stout basally but becoming slender in the distal half, and is moderately curved. The cirri are moderately compressed in the distal two-thirds. The two or three segments before the penultimate have slight traces of terminal dorsal tubercles.

The ends of the basal rays are visible as large rhombic tubercles in the angles of the calyx.

The radials are visible only as a large transversely oval tubercle between the centrodorsal and the IBr_1. The IBr_1 are very short, arcuate, in close lateral apposition; the proximal border is more or less crenulate and bears a large and rather high transversely oval median tubercle. The IBr_2 (axillaries) are rhombic, very short, somewhat over twice as broad as long, with the edges somewhat crenulate and somewhat produced, the proximal imbricating more or less over the distal border of the IBr_1; the lateral edges are very short and are in close apposition. The IBr_2 bear a rather high rounded median tubercle. The IIBr series are 4(3+4), in close lateral apposition and sharply flattened, with the lateral borders somewhat everted. The distal edge of the $IIBr_1$ is somewhat everted, and the proximal edge of the $IIBr_2$ is more strongly everted, the latter imbricating over the former except in the median line. The $IIBr_1$ usually bears a strong rounded median tubercle like that on the two components of the IBr series.

The 13 arms in the type specimen are 170 mm. long, elongated and comparatively slender, resembling those of *Pachylometra robusta*.

The pinnules in general resemble those of *Pachylometra robusta;* those in the proximal portion of the arm are strongly carinate.

The disk is covered with a pavement of very small plates. Side and covering plates are well developed along the pinnule ambulacra.

The color in alcohol is white.

Notes.—The specimen from south of Timorlaut has 14 arms about 150 mm. long.

In 1929 I described *Perissometra occidentalis* as follows:

The centrodorsal is large, truncated conical, with the cirrus sockets arranged in 10 closely crowded columns of usually 3 each.

The cirri are about XXV, 15–18, moderately stout, the longest from 30 to 35 mm. in length. The first segment is very short, the second is longer, the third is about twice as broad as long, the fourth is nearly as long as broad, and the fifth is about one-third again as long as broad on the longest peripheral cirri, and very slightly longer than broad on the other cirri. The following segments decrease in length so that the last seven or eight before the penultimate are about as long as broad. The penultimate segment is narrower than those preceding, and in lateral view is from one-third to one-half again as long as broad. From the fifth onward the segments in lateral view have slightly diverging ventral and dorsal edges, and their distal ends slightly overlap the bases of the segments following. On the dorsal side the distal end of the segments may be thickened so as to project considerably beyond the base of the succeeding segments, giving the dorsal profile of the outer portion of the cirri a low and roundedly serrate appearance. The opposing spine, which arises from the conspicuous white terminal band on the penultimate segment, is transversely broadened, with the crest chisel-shaped or strongly bilobate.

The ends of the basal rays are visible as prominent rhombic tubercles in the interradial angles.

The radials are entirely concealed by the centrodorsal. The IBr_1 are very narrow and bandlike, usually quite concealed by the centrodorsal except for a rounded median tubercle and the very narrow and irregular lateral portions, which extend diagonally outward, meeting those of the adjacent IBr_1 above the ends of the basal rays. The borders of these lateral portions are sinuate, and the distal angle is usually produced inwardly in the form of a conspicuous tooth which fits into a corresponding cavity beneath the lateral angle of the axillary. The IBr_2 (axillaries) are broadly rhombic with the lateral angles slightly truncated forming short sides, which are about as long as the length of the lateral portions of the IBr_1. The median portion of the axillaries is elevated, rising regularly into a very broadly rounded tubercle with the maximum height in about the proximal third. The proximal border of the axillary, except in the median line, is produced into a flangelike extension with a sinuous and more or less irregular edge, the irregularities fitting into corresponding irregularities in the adjacent border of the IBr_1. There are five IIBr series present, four of these being 4(3+4) and one being 2. The division series are smooth dorsally and rise evenly to a very broadly convex central portion. They are closely appressed against their neighbors. The $IIBr_1$ are very short and their inner portion is extended distally and is terminated by a short side at right angles to the lateral edge, which is usually more or less produced inwardly in the form of a tooth fitting into a notch in the $IIBr_2$.

The 15 arms are about 130 mm. long. The first brachials are very short, five or six times as broad as long, with the inner portion curving about and extending to beyond the middle of the second brachial where it is bounded by a line at right angles to the lateral edge. The inner corner of this distal border is extended in the form of a more or less pronounced tooth which fits deeply into a corresponding excavation in the side of the second brachials. The second brachials are about twice as long as the first. They are irregularly half-moon shaped, as a result of the overlapping of their proximal portion by the distal extensions of the first brachials, but their inner angles are somewhat abruptly produced over the ends of these processes, coming into lateral contact. The lateral borders of the first two brachials are slightly turned outward. On arms arising directly from a IBr axillary the first syzygial pair (composed of brachials 3+4) is about three times as broad as long, oblong, but with the proximal and distal borders broadly sinuous. The next seven brachials are wedge-shaped, about three times as broad as the median length, and those following become triangular, about as long as broad, and wedge-shaped again in the outer portion of the arms.

P_1 is 12 mm. long and is composed of 30 segments. It is rather stout at the base, but tapers evenly and rather rapidly so that the distal fourth is slender and delicate. The first segment is large, much broader than long, and is extended distally both at the dorsal and ventral angles so as to overlap for some distance the proximal angles of the second. The second segment is scarcely two-thirds as broad as the first, not quite twice as broad as long; its distal dorsal and ventral angles are extended slightly forward, and are more or less blunted or rounded off. The third segment is similar, but the distal processes are shorter and more broadly rounded. The following segments have the outer portion of the distal border curved toward the pinnule tip. The segments increase in length very slowly, not becoming as long as broad until very near the pinnule tip. All the segments, except those at the extreme end of the pinnule, are somewhat produced dorsally and sharply carinate.

P_2 is 13 mm. long, stouter than P_1 and tapering more gradually so as to lack the delicate tip. It is composed of 25 segments which become as long as broad on the twelfth and somewhat longer than broad terminally.

P_3 is 13 mm. long with 20 segments, tapering still more gradually than P_2. The segments become as long as broad on about the twelfth, and slightly longer than broad distally.

On the genital pinnules the third, fourth, and fifth segments are somewhat enlarged and broadened to protect the gonads.

The distal pinnules are 13 mm. long with about 16 segments, most of which are from half again to twice as long as broad.

Examination of enlarged photographs of the type specimens of *macilenta* and *occidentalis* fails to reveal any significant character by means of which they may be distinguished.

Localities.—South of Timorlaut (lat. 11° S., long 131°30′ E.; 914 meters; cable repair ship *Patrol*, Eastern and Associated Telegraph Company [A. H. Clark, 1929] (1, B. M.).

Laccadive Islands (lat. 10°47′45″ N., long. 72°40′20″ E.); 1,288 meters; *Investigator* [A. H. Clark, 1909, 1912, 1916, 1918; Gislén, 1934] (1, I. M.).

One hundred and twenty miles off the Seychelles; 1,462 meters; cable repair ship *Lady Denison-Pender*, Eastern and Associated Telegraph Co. [A. H. Clark, 1929] (1, B. M.).

History.—This species was first described under the name of *Pachylometra macilenta* in 1909 from a single specimen dredged among the Laccadive Islands by the Royal Indian Marine Survey steamer *Investigator*. It was redescribed and figured in my memoir on the crinoids of the Indian Ocean published in 1912. On the establishment of the genus *Perissometra* in 1916 *macilenta* was transferred to it, and in my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 *macilenta* was included in the key to the species of *Perissometra* and the synonymy and range were given. In 1929 I recorded and gave notes on another specimen that had been brought up on a cable south of Timorlaut by the cable repair ship *Patrol* of the Eastern and Associated Telegraph Company. In the same paper I described and figured under the name *Perissometra occidentalis*, sp. nov., a specimen from 120 miles off the Seychelles found on a cable by the cable repair ship *Lady Denison-Pender* of the same company.

In 1934 Prof. Torsten Gislén selected *Perissometra macilenta* as representing a special type of crinoid arm division including also *Pachylometra distincta* and *P. inaequalis*.

GLYPTOMETRA ANGUSTICALYX (P. H. Carpenter)

[See vol. 1, pt. 1, figs. 275, p. 260, 490, p. 367; pt. 2, pl. 3, figs. 984, 985, pl. 14, fig. 1055, pl. 26, fig. 1159, pl. 42, figs. 1270–1272.]

Antedon, sp. P. H. Carpenter, Pop. Sci. Rev., vol. 4, No. 15, 1880, p. 194, pl. 6, fig. 12 (plated disk).

Antedon angusticalyx von Graff, *Challenger* Reports, Zool., vol. 10, pt. 27, 1884, pp. 17, 70 (*Challenger* sta. 214; myzostomes; *nomen nudum*).—P. H. Carpenter, *Challenger* Reports, Zool., vol. 11, pt. 32, 1884, pp. 57, 83, 84, 93, 109, 110, 113, 128, 135, pl. 54, fig. 5, pl. 55, fig. 6.—von Graff, *Challenger* Reports, Narrative, vol. 1, pt. 1, 1885, p. 316 (myzostomes).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 242 (description; *Challenger* station 214), pl. 2, figs. 4, *a-d*, pl. 50, figs. 1, 2, text fig. 5, B, p. 246.—Springer, Mem. Mus. Comp. Zool., vol. 25, No. 1, 1901, p. 45 (tegmen compared with that of *Holocrinus*).—Minckert, Arch. Naturg., Jahrg. 71, 1905, vol. 1, Heft 1, p. 224 (syzygies; regeneration).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1582 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 35 (identity).

Charitometra angusticalyx A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed); Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, p. 227 (compared with *Ch. smithi*).

Pachylometra angusticalyx A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 21 (listed); Proc. U. S. Nat. Mus., vol. 36, 1909, p. 407 (compared with *P. levigata*); vol. 37, 1909, p. 34 (same constriction of proximal portion occurs in *Ptilometra splendida*); Crinoids of the Indian Ocean, 1912, p. 35 (identity), p. 216 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 47 (published reference to specimens in the B. M.; *Challenger* station 214).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 280; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 21, 22.

Perissometra angusticalyx A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 176 (in key; range), p. 178 (references).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, No. 35 (notes).

Diagnostic features.—The proximal portion of the animal is constricted, the sides of the IBr series being parallel or nearly so, the IIBr series somewhat abruptly turned outward; the cirri have 18–23 segments of which all but the basal are longer than broad; the 14-20 arms are 75 mm. long; and the division series and arm bases are smooth.

Description.—The centrodorsal is a truncated hemisphere, marked by indistinct interradial ridges which are produced upward into rather prominent processes between the radials. The cirrus sockets (according to the figure) are arranged in 10 columns of 2 or 3 each, the columns being in close contact interradially but separated by a broad shallow groove in the midradial line.

The cirri are XX–XXV, 18–23. According to the figure the segments beyond the basal are all longer than broad, most of them about half again as long as broad. There is no opposing spine.

The radials are concealed. The IBr_1 are quite short, especially in the median line, and are barely in contact above the angles of the centrodorsal. According to the figure they form a deeply U-shaped rather narrow band about the broadly rounded posterior projection of the axillary, which sometimes almost reaches the centrodorsal. The IBr_2 (axillaries) are somewhat broader than long, deeply shield-shaped with the distal angle very obtuse, scarcely rising higher than the anterolateral angles, and a long broadly rounded posterior projection. The IIBr series are 4(3+4) and, together with a few of the proximal brachials, are in close lateral apposition and sharply flattened laterally. The first two elements of the IIBr series are somewhat tubercular.

The 14–20 arms are 75 mm. long and are composed of over 100 brachials of which the lowest are nearly oblong and their successors triangular, broader than long, gradually becoming longer and more wedge-shaped.

In arms arising from a IBr axillary the first syzygy is between brachials 3+4 and the next is from between brachials 12+13 to between brachials 16+17. In arms arising from IIBr axillary the first syzygy is usually between brachials 1+2 and the next from between brachials 8+9 to between brachials 26+27, usually about brachials 13+14 or 15+16. The distal intersyzygial interval is from 5 to 13, usually 7 or 8, oblique muscular articulations.

P_D is about 9 mm. long with about 30 short carinate segments the lowest of which, though thick, are not especially broad. The next two or three pinnules are of about the same length with relatively longer distal segments, and the lower ones somewhat flatter. The following pinnules are a little shorter, with the first two segments smaller than in the proximal pinnules; but the third segment and from two to four of its successors are broad and flattened with the outer edges much produced toward the ventral side. Traces of this expansion may be visible as far as the twenty-fifth brachial, after which the segments become elongated and the pinnules more slender.

The disk is 7 mm. in diameter, much incised and completely plated, as are also the brachial ambulacra and the interarticular spaces. The gonads are covered by closely set plates in which sacculi are embedded. These are small and inconspicuous on the pinnule ambulacra, which have well-defined side plates.

The color in alcohol is light whitish brown.

Notes.—Carpenter's specimens in the British Museum have been examined by Professor Gislén and by myself, but neither of us had anything to add to the original description and figures.

Locality.—*Challenger* station 214; off the Meangis Islands (lat. 4°33′ N., long. 127°06′ E.); 914 meters; bottom temperature 5.44° C.; blue mud; February 10, 1875

[P. H. Carpenter, 1880, 1884, 1888; von Graff, 1884, 1885; Springer, 1901; Minckert, 1905; Hamann, 1907; A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1916, 1918; Gislén, 1924, 1928, 1934] (5, B.M.).

History.—Dr. P. H. Carpenter in 1880 published a figure of a plated disk of a comatulid identified only as *Antedon*, sp.

In 1884 Prof. Ludwig von Graff described some myzostomes from *Antedon angusticalyx* from *Challenger* station 214. The name, which had been given him by Dr. P. H. Carpenter, was a *nomen nudum.*

In his report on the stalked crinoids of the *Challenger* Expedition Dr. Carpenter gave a "specific formula" for this species, which is the equivalent of a description. He described the swollen genital pinnules in detail, noting that they receive no branches from the brachial food grooves and lack the ambulacral epithelium, nerves, and blood vessels, while the water vessels are simple tubes like the integumentary water vessels of the Molpadiidae without lateral extensions, since the tentacles are absent. He remarked that the fertile intrapinnular portions of the gonads are short, thick, and rounded, and that the sacculi occupy little pits in the large plates that cover the ovarian pinnules, and also in the substratum of the small later segments of the pinnules. He said that the ambulacra crossing plated disks are generally marked by an irregular row of transversely oblong plates, as in this species. He gave a figure of an ovarian pinnule and republished the figure of a plated disk published in 1880, identifying it as *Antedon angusticalyx.*

Professor von Graff again mentioned the myzostomes of *Antedon angusticalyx* in 1885.

In the *Challenger* report on the comatulids published in 1888 Dr. Carpenter described *Antedon angusticalyx* in detail and figured it. Wilhelm Minckert discussed the distribution of the syzygies in this species in 1905.

In my first revision of the old genus *Antedon* published in 1907 *angusticalyx* was assigned to the new genus *Charitometra*, and as *Charitometra angusticalyx* it was compared with the new species *Charitometra smithi* in 1908. In 1909 this species was transferred to the new genus *Pachylometra*, and *Pachylometra angusticalyx* was compared with the new species *P. levigata.* In the same year the constriction of the proximal portion of this species was compared with a parallel constriction of the proximal portion of *Ptilometra splendida.*

In my memoir on the crinoids of the Indian Ocean published in 1912 *Pachylometra angusticalyx* was listed and the synonymy and range were given. In 1913 I noted that I had examined five small specimens from *Challenger* station 214, the type material, in the British Museum.

In 1916 *angusticalyx* was transferred to the new genus *Perissometra* and listed as *Perissometra angusticalyx*, and in my memoir on the unstalked crinoids of the *Siboga* Expedition *Perissometra angusticalyx* was included in a key to the species of that genus, and the synonymy and range were given.

Prof. Torsten Gislén in 1924 noted that Carpenter in 1884 had pointed out that two representatives of the family Charitometridae, later identified as *Poecilometra acoela* and *Pachylometra angusticalyx*, sometimes lack the ambulacral grooves on as many as 20 pairs of proximal pinnules. In 1928 he noted that he had examined the *Challenger* specimens of *Perissometra angusticalyx* and that the species should be referred to the genus *Crossometra;* he remarked upon the unsatisfactory nature of *Perissometra* and *Crossometra* as understood by me. In 1934 he discussed what he termed the *Pachylometra angusticalyx* type of arm branching.

GLYPTOMETRA SPARKSI (John)

Pachylometra, n. sp., A. H. Clark, Proc. U. S. Nat. Mus., vol. 40, 1911, p. 51 (lat. 14°20′ N., long. 52°30′ E., 1,200 fathoms; *Electra*); Crinoids of the Indian Ocean, 1912, p. 224 (same); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 70 (same); John Murray Exped. 1933–34, Sci. Rep., vol. 4, No. 1, 1936 (Jan. 1, 1937), pp. 101 (same), 104, 105.

Perissometra sparksi John, Ann. Mag. Nat. Hist., ser. 10, vol. 20, p. 161, August 1937.

Diagnostic features.—The cirri, which are heavy and strongly curved, are arranged in 10 columns on the centrodorsal; they are composed of 14–21 segments of which all but the basal are longer than broad; there are 14 arms in the type specimen; and the division series and arm bases are moderately broad and smooth.

Description.—The centrodorsal is a thick disk with a flattened dorsal pole and strongly produced interradial angles. The cirrus sockets are arranged in 10 columns of 3 each, 2 columns in each radial area. The two columns in one radial area touch at the dorsal pole but diverge toward the periphery so as to run to the interradial angles. The two adjacent columns of contiguous radial areas are in close contact.

The cirri are XXXI, 14–21, heavy and strongly curved. The first three segments are broader than long, the first more so than the second, and the second than the third. The fourth is as long as broad. The remainder are longer than broad, the sixth to about the tenth being more than half again as long as broad; those beyond decrease very slightly in length. The articulations are only a little swollen. There is no trace of dorsal spines. The distal half to third of the penultimate segment, the opposing spine, and the terminal claw are sharply marked off through being of a lighter color than the rest of the cirrus. The opposing spine is low, or very low. The terminal claw varies from stout, moderately curved, and shorter than the penultimate segment to small and less than half as long as the penultimate segment.

The ends of the basal rays and the radials are concealed. The IBr_1 are short and roughly crescentic. They are longest (1) in the midradial line where they are produced backward between the interradial corners of the centrodorsal, either narrowly to a point, or more broadly not to a point, but evenly; and (2) laterally where they are produced anteriorly alongside the IBr_2, which they therefore appear to grip. The proximal edge is variable and uneven. The distal edge is produced into a rounded angle in the midline incising the posterior angle of the IBr_2. The IBr_2 (axillaries) are about three times as broad as the greatest length, which is along the median line. The proximal and distal edges of the middle two-thirds of the ossicle are convex, the former more strongly so than the latter except that it is incised in the midline by the IBr_1. Each lateral sixth beyond the projections of the lateral edges of the IBr_1 is marked off by a constriction, and each is square and incises the proximal exterior corner of the $IIBr_1$ beyond it. The distal median portion of the IBr_1 is very slightly elevated to form a low wide inconspicuous mound with the proximal median portion of the IBr_2, which is similarly raised. The $IIBr_1$ has the shape of a thick shallow cup, the median two-thirds of the distal half being deeply excavated. The proximal edge of the median two-thirds of the $IIBr_2$ is produced backward to occupy the concavity in the $IIBr_1$; its distal edge is faintly concave. The ossicles of the division series are free from tubercles. Their dorsal surfaces are convex except for flat strips along the lateral edges. The lateral edges are straight and the sides are flattened. There are four IIBr series, one on each of four rays; three of these are 4(3+4) and one is 2.

There were originally 14 arms. Only 5 arms, all 3 of one ray and two, which have been regenerated, of another remain nearly complete. It is impossible to say how long the arms were in life. An incomplete arm of 36 brachials measures 40 mm. The first two brachials of an arm arising directly from a IBr axillary are shaped like the $IIBr_1$ and $IIBr_2$ described above. Those of an arm arising from a IIBr axillary are roughly rectangular except that the distal interior corner of each is produced. They are nearly or quite three times as broad as long. The first syzygial pair (composed of brachials 3+4) is rectangular and may be twice as broad as long. The brachials immediately following are slightly wedge-shaped, more than half again as broad as long; those farther out are nearly triangular and as long as broad. The brachials are smooth. There are detached pieces of the outer arm which show that the outer brachials are of the shape of those just described, with their distal edges slightly produced.

In the one remaining arm of those springing directly from a IBr axillary syzygies occur between brachials 3+4, 7+8, and 15+16, and thereafter at intervals of 4 or 5 muscular articulations (as far as the thirty-second brachial, at which the arm is broken off). In an arm springing from a IIBr axillary, complete to the thirty-eight brachial, the syzygies occur between brachials 3+4, 11+12, 19+20, 30+31, and 37+38. In fragments of the more distal parts of the arm syzygies occur at intervals of from 4 to 8 muscular articulations.

No P_D remains complete. The least damaged is of 24 segments and is 8 mm. long. The first segment is large, more than twice as broad as long, and flattened exteriorly. On the following ten segments there is a gradual decrease in width; the eleventh is nearly as long as broad. The more distal segments are small and even, nearly as long as broad. All the segments, but particularly the larger proximal segments, are carinate dorsally; the carination of each is produced a little toward the next. P_1 is 14 mm. long, and is composed of 34 segments of which the first six or seven are heavy, nearly twice as broad as long, but gradually decreasing in size. The other segments are small, very gradually decreasing in size, all slightly broader than long. All the segments are faintly carinate. There is not such a contrast between heavy basal and lighter distal segments as there is in P_D. P_2 is about 9 mm. long, of 17 segments. The first eight segments are large, wider than long, and faintly carinate dorsally. The remainder are smaller, rounded, longer than broad, and gradually increasing in length. The genital pinnules are about 8 mm. long with 13–15 segments. The first two segments are short, and the third and fourth are larger, the largest in the pinnule, considerably broader than long. The distal dorsal end of each, but particularly of the fourth, is raised and produced a little. The fifth segment is narrower, roughly as long as broad. There is an abrupt transition between the first five and the following segments; the sixth and following are regular, laterally compressed, narrow, longer than broad, and slowly increase in length so that the distal segments are nearly twice as long as broad. The more distal pinnules are about 10 mm. long with 15–17 segments of which all but the first two are similar, rectangular, slightly longer than broad, and slowly decreasing in size.

The pinnule ambulacra are heavily plated.

Remarks.—Mr. John said that, unlike most of the other species of the genus, the IBr_1 and IBr_2 of *P. sparksi* are not raised into prominences big enough to be called "tubercles" or "carinations." *Perissometra crassa* from the Kei Islands has no prominences, and those of *P. occidentalis* from near the Seychelles are low. It is perhaps the latter species that *P. sparksi* most nearly resembles. The shapes of the ossicles of the division series are similar in both. But there are many differences, and the two species may be separated by the cirri alone—those of *P. sparksi* are composed of longer segments and are longer and smoother than those of *P. occidentalis.*

Locality.—Northwest of Sokotra (lat. 14°20′ N., long. 52°30′ E.); 2,194 meters; Capt. V. F. Sparks, cable repair ship *Electra*, July 1909 [A. H. Clark, 1911, 1912, 1913, 1937; John, 1937] (1, B. M.).

History.—During a visit to the British Museum in 1910 I examined the type specimen of this species, but did not have time to draw up a description of it. I mentioned it as *Pachylometra*, n. sp., in 1911, 1912, 1913, and 1937. It was formally described by D. Dilwyn John in 1937.

GLYPTOMETRA SCLATERI (Bell)

Antedon sclateri Bell, Marine investigations in South Africa, vol. 4, pt. 4, 1905, p. 140 (description; East London, NW. 1/2 N., 18 miles; 250–300 fathoms), pl. 3, figs. 1–3.—A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (belongs to *Charitometra*, near *inaequalis*); Proc. U. S. Nat. Mus., vol. 34, 1908, pp. 437, 493 (described in the *Savignyi* group; really belongs in the *Granulifera* group and is very close to *inaequalis*); vol. 40, 1911, p. 5 (identity); Crinoids of the Indian Ocean, 1912, p. 40 (identity).

Charitometra sclateri A. H. Clark, Proc. Biol. Soc. Washington, vol. 21, 1908, p. 126 (belongs in *Charitometra*, near *inaequalis*).

Pachylometra sclateri A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 21 (listed); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 5 (identity), p. 8 (southeast coast of Africa), p. 38 (synonymy; locality); Crinoids of the Indian Ocean, 1912, p. 40 (identity), p. 216 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 48 (published reference to specimens in the B. M.; stations 12676, 12711, 12792, 12885/6; no loc.; characters of the centrodorsal); Die Crinoïden der Antarktis, 1915, p. 164 (represents the family Charitometridae in South Africa; range); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 184 (in key; range), p. 185 (references).—H. L. Clark, Ann. South African Mus., vol. 13, pt. 7, No. 12, 1923, p. 234 (new localities; characters of 10-armed young).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8, No. 38 (notes).—A. H. Clark, John Murray Exped. 1933–34, Sci. Reports, vol. 4, No. 4, 1936, pp. 101 (range), 105.—Gislén, Kungl. Svenska Vet. Akad. Handl., ser. 3, vol. 17, No. 2, Oct. 3, 1938, p. 4, p. 18 (localities; notes), figs. 16, 17, p. 19, pl. 2, fig. 7.

Diagnostic features.—The cirri are arranged in 10 columns on the centrodorsal; they are 18–20 mm. long with 16 segments of which all but the basal are longer than broad; there are 11–17 arms; and the division series and arm bases are smooth and very broad.

Description.—Bell's original description is as follows:

> This somewhat variable species appears to belong to Division II of Carpenter's *A. savignyi* group (see Chall. Report Comat., p. 252). There are not as many as 20 joints in the cirri, and may be no more than 15, the distichal pinnule is small, and there are no lateral processes to the pinnules; there are 20 arms or less, but always more than 10.
>
> The cirri vary not only in the number of joints, but in the length of them, so that what appear to be fully developed cirri may be less than 15 or more than 30 mm. long; the increase in length is due rather to the increased length of the joints than to an increase in number.

The figure, drawn by Mr. C. Berjeau, who drew many of the excellent figures for the *Challenger* report on the comatulids (plates 1–5, and in cooperation with Highley plates 6–37, 63, 66, and 70) and therefore may be regarded as reliable, shows a species with the proximal profile broadly rounded as in *G. septentrionalis.*

According to Gislén the cirri are arranged in 10 columns on the centrodorsal. The figure shows them to have about 16 segments and Dr. Hubert Lyman Clark says they are 18–20 mm. long. All but the basal segments are longer than broad, the longest from half again to twice as long as broad, the distal from slightly longer than broad to nearly half again as long as broad. Berjeau shows a slight opposing spine which Gislén says is spiny.

The radials are concealed, and the IBr_1 may be more or less concealed. In the figure six IIBr series are shown of which five are 4(3+4) and one is 2. The division series and lower brachials are apparently evenly rounded dorsally and not rugose.

There are 11–17 arms.

The first syzygy appears to be between brachials 1+2 and the next from between brachials 11+12 to between brachials 13+14.

P_1 is shown as slender, tapering evenly from the base to the tip, flexible, with 31 segments of which the earlier are somewhat broader than long and the distal are longer than broad. P_2 is similar. P_3 and P_4 are of about the same length but have only 18 segments of which the second-fifth or -sixth are considerably broadened, the pinnule beyond these tapering graually to a slender tip.

Notes.—I examined 28 specimens of this species in the British Museum and noted that the centrodorsal bears radial furrows, which would indicate that the cirri are arranged in 10 columns, 2 in each radial area; but in the *Siboga* report I ranged this species with those having the cirri in 15 columns. Gislén in 1928 wrote that in *sclateri* the cirri are in 10 columns and called attention to the fact that I had placed it with species having the cirri in 15 columns. The arms in the specimens examined by him varied from 11 to 17.

Localities.—*Pieter Faure* Nos. 12676 and 12711; East London bearing N. W., 1/2 N., 18 miles distant; 457–548 meters: hard ground and broken shells [Bell, 1905: A. H. Clark, 1908, 1909, 1911, 1912, 1913, 1915, 1918, 1936; H. L. Clark, 1923; Gislén, 1928, 1934] (12, B. M.).

Pieter Faure No. 12872; East London bearing N., 15 miles distant; 566 meters; mud [H. L. Clark, 1923].

Pieter Faure No. 12792 [A. H. Clark, 1913] (4, B. M.).

Pieter Faure No. 12885/6 [A. H. Clark, 1913] (1, B. M.).

Pieter Faure; no locality [A. H. Clark, 1913] (11, B. M.).

Geographical range.—Known only from off East London, South Africa.

Bathymetrical range.—From 548 (?457) to 566 meters.

History.—*Antedon sclateri* was described by Prof. Francis Jeffrey Bell in 1905 from specimens dredged off East London, South Africa by the fisheries steamer *Pieter Faure* in the course of marine investigations of the South African coasts. Professor Bell placed the species in Carpenter's *Savignyi* group, which included the species of *Heterometra* and *Craspedometra,* entirely overlooking the plating of the pinnule and brachial ambulacra.

At the time I published my first review of the genus *Antedon* in 1907 I had not been able to consult Professor Bell's paper; but in 1908 I wrote that *Antedon sclateri* belongs to the genus *Charitometra* and is near *C. inaequalis.* In another paper published later in the same year I noted that Bell had referred *Antedon sclateri* to Carpenter's *Savignyi* group whereas it is in reality a member of the *Granulifera* group and is very close to *Charitometra inaequalis.* In my revision of the families Thalassometridae (at that time including the Charitometridae) and Himerometridae published in 1909 I established the new genus *Pachylometra* and listed *sclateri* under it. In my memoir on the recent crinoids of the coasts of Africa published in 1911 I identified *Antedon sclateri* as *Pachylometra sclateri* and gave the synonymy and locality. It was again listed as *Pachylometra sclateri* in my memoir on the crinoids of the Indian Ocean published in 1912. After examining the crinoids in the British Museum I recorded 28 specimens of *Pachylometra sclateri* under *Pieter Faure* numbers 12676 (5), 12711 (7), 12792 (4), and 12885/6 (1), and also 11 from the *Pieter Faure* collection without locality; but the note on them was that the centrodorsal shows radial furrows. In my memoir on the crinoids of the Antarctic published in 1915 I said that *Pachylometra sclateri* represents the family Charitometridae in South Africa, and gave the range. In my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 *sclateri* was included in the key to the species of *Pachylometra* and the synonymy and range were given. In his memoir on the echinoderm fauna of South Africa published in 1923 Dr. Hubert Lyman Clark recorded an adult specimen from *Pieter Faure* number 12872 which he said had the calyx about 12 mm. in diameter and the cirri 18–20 mm. long, and in addition what he believed to be the 10-armed young from *Pieter Faure* numbers 12884 (1) and 13227 (13), giving notes on the latter.

After studying the comatulids in the British Museum Prof. Torsten Gislén in 1928 wrote that the centrodorsal in *Pachylometra sclateri* is discoidal, the cirri are arranged in 10 columns and are without dorsal spines, and the opposing spine is spiny (presumably meaning sharp). The specimens he examined had 11, 14, 16, and 17 arms. In my report on the crinoids of the John Murray Expedition to the Indian Ocean 1933–34, published in 1937 I listed *Pachylometra sclateri* and gave the range. In his paper on crinoids from South Africa published in 1938 Professor Gislén gave notes on and figured four small 10-armed specimens which he tentatively referred to *Pachylometra sclateri.* The smaller specimens (Nos. 1-3) were from one of the stations from which Dr. Clark's small specimens came; the largest (No. 4) had been collected by Dr. Th. Mortensen. In the last the keel on the dorsal side of the cirrus segments is somewhat more distinct and the lateral sculpture of the arm-bases is a little more obvious, but the general appearance and distance of the syzygies is the same. However, he added, the specimen is still 10-armed and the ossicles of the division series much longer (a characteristic which may of course be an indication of youth) then in the specimen figured by Bell. In fact, he said, the genital pinnules are closely reminiscent of *Charitometra.* Provided that it is not a young of *Pachylometra sclateri* it is a new species which may probably be most correctly ranged within the 10-armed genus *Charitometra.*

The small 10-armed specimens recorded by Dr. H. L. Clark and Professor Gislén as the young of *Pachylometra sclateri* are in reality adults of *Gislénometra perplexa* of the family Colobometridae (see Part 4b, p. 59).

GLYPTOMETRA LEVIGATA (A. H. Clark

PLATE 27, FIGURES 82, 83

[See also vol. 1, pt. 2, fig, 671, p. 335.]

Pachylometra levigata A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 406 (description; *Albatross* station 5236); Crinoids of the Indian Ocean, 1912, p. 224 (synonymy; locality); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 184 (in key; range), p. 185 (references).

Pachylometra laevigata GISLÉN, Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 482 (perhaps a species of *Crinometra*).

Diagnostic features.—The cirrus sockets are arranged in 15 columns on the centrodorsal; the cirri are 15 mm. long with 14–15 segments, all of which are longer than broad, the longest earlier segments half again as long as broad; the 12–14 arms are 100 mm. long; and the division series and arm bases are smooth, without ornamentation.

Description.—The centrodorsal is thick-discoidal or more or less columnar with the flat polar area 2.5 or 3 mm. in diameter. The cirrus sockets are arranged in three columns in each radial area, the two outer columns converging distally and usually meeting beyond the middle column. The columns are usually separated by more or less developed ridges.

The cirri are XXX–XXXV, 14–15, 15 mm. long. The first two segments are about twice as broad as long, the third is about as long as broad, and the fourth to the seventh or eighth are half again as long as broad; the segments following gradually decrease in length, the third and fourth from the end being only slightly longer than broad. The terminal segments are again about half again as long as broad. The distal ventral ends of the segments are slightly prominent, and the distal dorsal ends of the outer segments are sometimes slightly thickened. The opposing spine is minute, terminally situated, and directed obliquely forward; it is often barely indicated or entirely absent. The terminal claw is nearly as long as the penultimate segment, moderately slender and moderately curved.

The ends of the basal rays are usually visible as dorsoventrally elongate tubercles in the angles of the calyx, but are sometimes quite concealed.

The radials are concealed. The IBr_1 are usually entirely concealed in the median line but slightly visible over the ends of the basal rays; they are sometimes visible as a narrow line along the proximal border of the axillaries. The IBr_2 (axillaries) are rhombic, twice as broad as long, with all the sides somewhat incurved, and rise in the proximal half to a large rounded tubercle. The IIBr series are 4(3+4), rarely 2, in close apposition and strongly flattened laterally.

The 12–14 arms are 100 mm. long. The first eight or nine brachials are wedge-shaped or almost oblong, about twice as broad as long, and are more or less tubercular. The brachials following are triangular, about as long as broad, becoming in the terminal portion of the arms wedge-shaped and longer than broad.

In arms arising from a IBr axillary the first syzygy is between brachials 3+4, the second between brachials 14+15 or 15+16, and the distal intersyzygial interval is from 6 to 16 oblique muscular articulations. In arms arising from a IIBr axillary the first syzygy is between brachials 1+2 or 2+3.

The pinnules resemble those of *G. angusticalyx*, but the expansion of the genital pinnules is somewhat more marked.

The disk is completely covered with a pavement of small plates. The brachial and pinnule ambulacra are well plated, and there are large irregular plates over the gonads.

The color in life is yellow.

Localities.—*Albatross* station 5236; east coast of Mindanao, north of Lianza Bay; Magabao Island (S.) bearing N. 85° W., 9.10 miles distant (lat. 8°50′45″ N., long. 126°26′52″ E.); 903 meters; bottom temperature 5.11° C.; fine gray sand; May 11, 1908 [A. H. Clark, 1909, 1912, 1918] (3, U.S.N.M., 25464 [type], 35688).

Albatross station 5349; Palawan Passage; Point Tabonan bearing N. 85° E., 42.5 miles distant (lat. 10°54′00″ N., long. 118°26′20″ E.); 1,334 meters; bottom temperature 4.83° C.; coral sand; December 27, 1908 (4, U.S.N.M., 35956).

Albatross station 5367; Verde Island Passage; Malabrigo Light bearing N. 81° E., 8 miles distant (lat. 13°34′37″ N., long. 121°07′30″ E.); 329 meters; sand; February 22, 1909 (1, U.S.N.M., 35896).

Geographical range.—Philippine Islands.

Bathymetrical range.—From 329 to 1,334 meters.

Thermal range.—From 4.83° to 5.11° C.

History.—This species was described under the name of *Pachylometra levigata* in 1909 from a specimen from *Albatross* station 5236. In my memoir on the crinoids of the Indian Ocean published in 1912 *Pachylometra levigata* was listed and the range and synonymy were given. In my report on the unstalked crinoids of the *Siboga* Expedition published in 1918 *levigata* was included in the key to the species of *Pachylometra* and the synonymy and range were given.

GLYPTOMETRA LATA (A. H. Clark)

PLATE 28, FIGURES 84–86; PLATE 29, FIGURE 88

[See also vol. 1, pt. 2, figs. 306, p. 223, 658, p. 329.]

Antedon lata A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 140 (description; *Albatross* station 4918).

Charitometra lata A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 228 (compared with *Ch.* [*Calyptometra*] *lateralis*), p. 312 (Sagami Bay, Japan).

Glyptometra lata A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 19 (listed); vol. 25, 1912, p. 80 (compared with *G.* [*Perissometra*] *timorensis*); Crinoids of the Indian Ocean, 1912, p. 224 (synonymy; locality); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance).

Perissometra lata A. H. CLARK, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. IX (relationship with *P. timorensis*), p. 177 (in key; range), p. 182 (references).—GISLÉN, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 121 (compared with *P. aranea*); Vid. Medd. Dansk Nat. Foren. København, vol. 83, 1927, p. 35; Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 8.

Diagnostic features.—The cirri, which are arranged in 15 columns on the centrodorsal, are up to 25 mm. in length and are composed of 15–18 segments, of which the earlier are longer than broad and the distal are about as long as broad or broader than long; the 10 arms are 115–130 mm. long; and the IBr series and lower brachials are coarsely rugose, but their borders are not everted.

Description.—The centrodorsal is a thick disk with the bare polar area moderate or large and coarsely tubercular. The cirrus sockets are arranged in one and a more or less complete second row and in 15 columns, 3 in each radial area, the middle column in each radial area consisting of a single cirrus near the dorsal pole. In the Misaki specimen there are 10 cirri about the proximal rim of the centrodorsal, 7 of these having another just beneath it, and 5 smaller ones midradial in position about the dorsal pole.

The cirri are XV–XXII, 15–18, up to 25 mm. in length. The first segment is short, those following increasing in length to the sixth and seventh, which are from slightly longer than broad to about one-third again as long as broad, thence remaining uniform, or slowly decreasing to about as long as broad or, in the stoutest cirri, even slightly broader than long, toward the tip. The segments beyond the basal portion are very slightly flaring, and those in the distal third of the cirri have a slight well rounded tubercle dorsally at the distal end. The opposing spine is well developed, conical, stout, and blunt, terminal, and leaning slightly forward. The terminal claw is about as long as the penultimate segment, moderately stout, tapering more rapidly in the proximal third than distally, and moderately curved, most strongly in the basal third.

The ends of the basal rays are visible as dorsoventrally elongate tubercles in the angles of the calyx.

The radials are concealed or more or less of them may be visible beyond the rim of the centrodorsal. The IBr_1 are very short, bandlike, broadly V-shaped, with more or less coarsely crenulate edges and a central more or less circular low tubercle. The IBr_2 (axillaries) are rhombic, more than twice as broad as long, with the lateral angles truncated and the lateral borders slightly everted. The distal sides are rather strongly concave and there is a median tubercle narrower than that on the IBr_1 and dorsoventrally elongate in the proximal two-thirds. The elements of the IBr series and the first two brachials are closely appressed and sharply flattened laterally.

The 10 arms are 115–130 mm. long. The two first brachials are somewhat wedge-shaped, longer exteriorly than interiorly, the second rather larger than the first. They have a low and rather narrow raised median line and slightly everted borders. The first syzygial pair (composed of brachials 3+4) is oblong, about twice as broad as long; each element has a low median rounded tubercle, or the hypozygal may have a row of 4 or 5 small low rounded tubercles. The twelfth brachial is regularly oblong. The brachials between the first syzygial pair and the twelfth are slightly wedge-shaped, more than twice as broad as long with an uneven surface though not tubercular. After the twelfth the brachials become triangular, slightly broader than long, soon becoming about as long as broad. The lower triangular brachials have each an obsolescent median rounded tubercle. The distal ends of the brachials may be slightly produced, this condition, if present, tending to become more accentuated distally.

Syzygies occur between brachials 3+4, again at about brachials 13+14, and distally at intervals of from 8 to 11 muscular articulations.

P_1 is 10 mm. long, comparatively slender and tapering rather gradually from the base to the tip, and is composed of about 40 short segments of which the basal 8 or 10 are flattened exteriorly and rather broad. P_2 is much shorter than P_1 with about 23 segments of which the proximal 8 or 9 are much expanded laterally. P_3 resembles P_2 but is somewhat shorter and the 6 basal segments are even more expanded, reaching a maximum on the third and fourth, thence tapering to the tip. The following pinnules to about the fiftieth brachial are similar, but the number of segments increases from 12 on P_4 to 20 on the pinnule of the fiftieth brachial; as the great lateral expansion is always confined to the first 6 segments, reaching a maximum on the third or fourth then gradually decreasing to the sixth which distally is of normal diameter, the expanded segments covering the gonads progressively occupy less and less of the total length of the pinnule; while in the earlier pinnules they take up most of the length, in the pinnule of the fiftieth brachial they occupy barely the proximal third. The distal pinnules are 11 mm. long, slender, with about 20 elongated segments.

The disk is completely plated. The brachial and pinnule ambulacra are well plated. The sacculi are very small and inconspicuous.

The color in life is yellow to yellowish brown.

Notes.—A small specimen collected with the type has the arms 80 mm. long. In general it resembles the type, but the ends of the basal rays are more prominent, the dorsal surface of the IBr series and lower brachials is smooth, and the brachials are all proportionately longer.

The specimen from Misaki is larger than the type, having the arms 130 mm. in length. The elements of the IBr series and the first 2 brachials have a broad rounded median ridge instead of the broad central tubercle seen in the type. The general appearance is somewhat less rugged, though the style of ornamentation is the same. In its characters it is somewhat intermediate between the type and the small specimen collected at the same station. The outer ends of the radials are visible.

Localities.—*Albatross* station 4918; Eastern Sea, 10 to 20 miles southwest of the Koshika Islands; Gwaja Shima bearing S. 38′ E., 34 miles distant (lat. 30°22′00″ N., long. 129°08′30″ E.); 660 meters; bottom temperature 5.94° C.; gray sand, globigerinae, and broken shells; August 13, 1906 [A. H. Clark, 1907, 1908, 1909, 1912, 1915, 1916, 1918; Gislén, 1922, 1927, 1928] (2, U.S.N.M., 22628).

Sagami Bay; off Misaki; Alan Owston, yacht *Golden Hind*, July 1902 [A. H. Clark, 1908, 1912, 1918] (1, U.S.N.M., 35684 [original No. 6969]).

History.—This species was described in 1907 under the name of *Antedon lata* from a large specimen from *Albatross* station 4918. In my first revision of the genus *Antedon* published later in 1907 *lata* was referred to the new genus *Charitometra*. In my report, published in 1908, upon Alan Owston's collection of crinoids from southern Japan, which was purchased by Dr. Frank Springer and presented by him to the National Museum, I recorded another specimen of this species from off Misaki. In 1908 I compared *Charitometra lata* with a new species, *Charitometra* (*Pachylometra*) *lateralis*. On the establishment of the genus *Glyptometra* in 1909 *lata* was removed to it. In my memoir on the crinoids of the Indian Ocean published in 1912 *Glyptometra lata* was listed and the synonymy and range were given. In a short paper published in the same year I compared *Glyptometra lata* with a new species, *G. timorensis*. In 1915 *Glyptometra lata* was listed as a characteristic species of southern Japan and the range was given. On the creation of the new genus *Perissometra* in 1916 *lata* was placed in it. In my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 *lata* was included in the key to the species of *Perissometra*, the synonymy and localities were given, and its relationships with *P.* (*Glyptometra*) *timorensis* were discussed.

In 1922 Prof. Torsten Gislén compared *Perissometra lata* with his new species *P. aranea* (=*Parametra orion*), and in 1927 he remarked that *lata*, with *crassa* and perhaps other species of *Perissometra*, must be referred to *Glyptometra*. In 1928 he said that *lata*, with *patula*, *timorensis*, *flexilis*, and *aranea*, should be assigned to *Perissometra*.

GLYPTOMETRA INVENUSTA (A. H. Clark)

Plate 29, Figure 89

Pachylometra invenusta A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 149 (description; 11°46′30″ N., 93°16′00″ E.; 569 fathoms); Crinoids of the Indian Ocean, 1912, p. 220 (synonymy; detailed description; locality), fig. 40, p. 221.

Perissometra invenusta A. H. Clark, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 607 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 178 (in key; range), p. 181 (references).—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 22.

Diagnostic features.—The cirri, which are arranged in 15 columns on the centrodorsal, are 30–34 mm. long with 20–21 segments, of which the distal are markedly longer than broad; the 12 arms are 170 mm. long; and the division series and lower brachials have a rather fine rugose ornamentation, the proximal brachials each bearing a median small rounded tubercle.

Description.—The original description of this species is quite unsatisfactory. I said that this species is in general similar to *Glyptometra macilenta,* but differs in many details. The centrodorsal is not described. In the figure it is shown as a broadly truncated cone. The cirrus sockets in the radial area shown are 5 in number; there are 3 along the proximal border and 2 below, situated under the spaces between those above. This presumably indicates a species with the cirri in 15 columns, though the centrally situated cirrus socket may be adventitious.

The cirri are XXIII, 20–21, from 30 to 34 mm. long, rather slender, resembling those of *Glyptometra macilenta.* The proportions of the component segments are the same as in that species, but the distal edges of the segments are slightly more thickened, giving the cirri as a whole a somewhat rougher appearance.

The IIBr series are 4(3+4). The elements of the IBr and IIBr series and the first two brachials exteriorly and first three interiorly are in close lateral apposition and sharply flattened laterally, with the apposed edges somewhat everted. The ornamentation of the ossicles of the IBr and IIBr series is essentially as in *G. macilenta.*

The 12 arms are 170 mm. long, slender, as in *G. macilenta.* The brachials have the same proportions as those of *G. macilenta,* but the proximal subquadrangular brachials have the distal ends thickened and everted, and the remaining brachials have rather prominently overlapping distal edges. In the figure the proximal discoidal brachials are shown each with a small central tubercle.

The distal intersyzygial interval is 4 or 5 oblique muscular articulations.

The pinnules resemble those of *G. macilenta,* but the genital pinnules are more swollen than are those of that species.

The color in alcohol is dull yellowish white.

Locality.—Off South Andaman Island (lat. 11°46′30″ N., long. 93°16′00″ E.); 1,040 meters; bottom temperature 4.44° C.; green mud and foraminiferal ooze; *Investigator* [A. H. Clark, 1909, 1912, 1916, 1918; Gislén, 1934] (1, I. M.).

History.—*Pachylometra invenusta* was originally described in 1909 from a single specimen dredged by the Royal Indian Marine Survey steamer *Investigator* off South Andaman Island. It was redescribed and figured in 1912. On the establishment of the genus *Perissometra* in 1916 *invenusta* was transferred to it. In my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 *invenusta* was included in the key to the species of the genus *Perissometra* and the synonymy and locality were given. In 1934 Prof. Torsten Gislén listed *Perissometra invenusta* among the comatulids with the *Heterometra bengalensis* type of arm division.

GLYPTOMETRA LATERALIS (A. H. Clark)

PLATE 29, FIGURE 87

[See also vol. 1, pt. 1, fig. 370, p. 299; pt. 2, figs. 240, p. 197, 303, p. 223, 676, 677, p. 338, 868–873, p. 425, pl. 54, fig. 1347.]

Charitometra lateralis A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 214 (in key), p. 226 (description; *Albatross* station 4179; also stations 4177, 4180).

Glyptometra lateralis A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 19 (listed); vol. 25, 1912, p. 81 (comparison with *G.* [*Perissometra*] *timorensis*); Crinoids of the Indian Ocean, 1912, p. 224 (synonymy; locality); Bernice P. Bishop Mus. Bull. 195, 1949, p. 75 (*Albatross* stations 4177, 4179, 4180), p. 116 (station data).

Calyptometra lateralis A. H. CLARK, Journ. Washington Acad. Sci., vol. 6, No. 17, 1916, p. 608 (listed); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 189 (references).

Diagnostic features.—The cirri, which are arranged in 15 columns on the centrodorsal, are 30–40 mm. long with 15–21 segments of which the distal are markedly longer than broad; the 10 (rarely 11) arms are 160–180 mm. long and the division series and lower brachials are coarsely rugose with the lateral edges everted, each of the proximal brachials with a low broad hump.

Description.—The centrodorsal is very thick discoidal, or almost columnar, more rarely truncated conical. The closely crowded marginal cirrus sockets are arranged roughly in 2 rows and 15 columns.

The cirri are XXX, 15–21 (usually 16–19), from 30 mm. to 40 mm. in length. The first segment is about half as long as broad, the second is almost as long as broad, the third is rather longer than broad, and the remainder are about half again as long as broad. The last 4 or 5 segments have the median portion of the distal dorsal edge rather prominent, and the penultimate bears a small opposing spine which is usually a blunted tubercle, but sometimes sharp and directed obliquely distally. The terminal claw is not so long as the penultimate segment, and is moderately slender and moderately curved.

The ambulacra of the arms and pinnules are extensively plated.

The ends of the basal rays are visible as rounded tubercles in the interradial angles of the calyx.

The radials, and usually also all the IBr_1, are concealed by the centrodorsal. The IBr_2 (axillaries) are low and broad, about three times as broad as long, with the distal angle broad and usually more or less blunt or rounded. IIBr series, when present, are 2.

The 10 or 11 arms are 160 to 180 mm. in length. The first two brachials are oblong, very short, three or four times as broad as long. The first syzygial pair (composed of brachials 3+4) is about twice as broad as long. The following eight or nine brachials are wedge-shaped, about twice as broad as long, those succeeding becoming triangular, and after the eighteenth as long as broad, the terminal brachials becoming wedge-shaped again and elongate. The IBr_2 and the first three brachials have the proximal and distal edges everted and crenulate, often extravagantly so, dovetailing with the edges of the adjacent segments. The lateral edges of these ossicles are strongly everted and thin, those on adjacent arms being closely appressed and together standing out as narrow interradial keels which are equal in height to the proximal and distal eversion of the segments. The proximal three-fourths of the IBr_2 bears a prominent broadly rounded median ridge which becomes higher proximally, forming a tubercle with a similar ridge on the IBr_1 when that ossicle is visible. Similar rounded ridges occur on the proximal portion of the second brachials and the distal portion of the first brachials. The third brachial has a slight rounded median tubercle. The lateral edges of the proximal brachials up to about the fifteenth are turned outward and produced into a thin marginal flange, this feature becoming less and less marked distally and usually not noticeable after the fifteenth. The elements of the IBr series and the first 5 or 6 brachials are sharply flattened laterally and are in very close lateral apposition. The brachials, except for those at the bases of the arms, are rather strongly overlapping with finely serrate distal edges.

Syzygies occur between brachials 3+4, again in the vicinity of brachials 15+16, and distally at intervals of from 5 to 11 (usually 5 to 7) muscular articulations.

P_1 is 16 mm. long, tapering rapidly from a very broad base 2 mm. in width to about the middle, then remaining slender and flagellate to the tip. It is composed of 35 or more segments of which the basal are very broad, much broader than long, and those following become narrower and relatively longer to about the middle of the pinnule beyond which point they are about as long as broad. The whole pinnule is somewhat flattened, very much so basally. P_2 is 14 mm. long, similar to P_1 but not so much expanded basally. P_3 is 12 mm. long, rather stiffer than, and not flagellate like, P_1 and P_2, with 20 segments of which the lower are evenly expanded, this expansion increasing to the fourth or fifth, then gradually decreasing and ending at the eighth. The segments as far as the fifth or sixth are about twice as broad as long, and those succeeding increase in relative length, the comparatively slender segments following the eighth being about twice as long as broad. P_4 and the following pinnules are similar, but with the expansion of the lower segments more marked. Distally the basal expansion gradually occupies less and less of the pinnule and at the same time the pinnules become longer so that they have an increasingly long slender tip. After about P_{14} the basal expansion is not noticeable, the pinnules, though stout basally, tapering evenly from the base to the tip. The distal pinnules are 15 mm. long with the first segment short, slightly wedge-shaped, rather over twice as broad as long, the second similar but relatively longer, and the remainder about half again as long as broad, becoming about twice as long as broad distally.

The color in life is ochre yellow, the cirri clear lemon yellow (W. K. Fisher). The containing alcohol is stained either a deep orange red or emerald green.

Notes.—In the specimen from *Albatross* station 4180 with the arms 80 mm. long both the elements of the IBr series are visible, and the ends of the basal rays are prominent as vertically elongate tubercles in the angles of the calyx. The very broad character of the elements of the IBr series and lower brachials is marked, as is the eversion of their edges, especially the lateral edges; but the proximal and distal edges as yet have not taken on the crenulate feature characteristic of the fully grown. In this specimen one of the IBr axillaries bears a regenerating pair of arms replacing an arm lost, the IIBr series being 2, so that there are 11 arms.

In the smallest specimen the radials are visible; these have a pronounced rounded median ridge. The ends of the basal rays are prominent and project rather more than in the specimen just noticed. The unusual broadness of the IBr series and lower brachials is marked even at this early stage, though the brachials following are much elongated. The eversion of the lateral edges of the elements of the IBr series and lower brachials is already apparent.

Localities.—*Albatross* station 4177; Hawaiian Islands, off Niihau; Kawaioa Point bearing S. 54° W., 17.5 miles distant; 824–583 meters; bottom temperature 5.00° C.; gray sand and globigerinae; August 12, 1902 [A. H. Clark, 1908, 1909, 1912, 1916, 1918] (1, U.S.N.M., 35639).

Albatross station 4179; off Niihau; Kawahioa Point bearing S. 60°45′ W., 19.2 miles distant; 691–779 meters; bottom temperature 5.55° C.; coarse sand, rocks, and pebbles; August 12, 1902 [A. H. Clark, 1908, 1909, 1912, 1916, 1918] (5, U.S.N.M., 22688 [type], 35638; M. C. Z., 353).

Albatross station 4180; off Niihau; Kawahioa Point bearing S. 58° W., 19.5 miles distant; 779–762 meters; bottom temperature 5.05° C.; pebbles, globigerinae, and rocks; August 12, 1902 [A. H. Clark, 1908, 1909, 1912, 1916, 1918] (2, U.S.N.M., 35629).

Geographical range.—Known only from off Niihau, Hawaiian Islands.

Bathymetrical range.—Between 583 and 824 meters, but not definitely recorded from either extreme.

Thermal range.—From 5.00° to 5.55° C.

History.—This species was described as *Charitometra lateralis* in 1908 from one of six specimens from *Albatross* station 4179; at the same time other specimens were recorded from stations 4177 and 4180 and notes were given on them. *Charitometra lateralis* was said to belong to the same division of the genus as *tuberosa* from the Philippines and *lata* from Japan, differing from both in its larger size, much longer cirrus segments which are about half again as long as broad instead of about as long as broad, the prominent eversion of the lateral edge of the elements of the IBr series and lower brachials, and the absence of the dorsal carination of the lower part of the arm which is so characteristic a feature of *tuberosa*.

In 1909 I transferred *lateralis* to the new genus *Glyptometra*, and in 1912 compared it with a new species, *G. timorensis*. In my memoir on the crinoids of the Indian Ocean published later in 1912 *Glyptometra lateralis* was listed and the range and synonymy were given. In 1916 I established the genus *Calyptometra* for this species, and in my report on the unstalked crinoids of the *Siboga* Expedition published in 1918 I listed *Calyptometra lateralis* with the synonymy and range.

GLYPTOMETRA sp.

Locality.—Off Pratas reef, southeast of Hong Kong (lat. 21°10′ N., long. 117°30′ E.); 704 meters; Captain Suensson, May 22, 1911 (fragments, C. M.).

Notes.—Fragments of a specimen of a species of *Glyptometra* of the *G. invenusta* type from this locality are in the Copenhagen Museum. One postradial series *in situ* has one IIBr 4(3+4) series and three arms. The IBr_1 are granulated, and the edges of the axillaries all around are finely tubercular. The cirri are 40 mm. long with 19–20 segments of which the fourth is about as long as broad, the sixth and seventh are nearly twice as long as broad, and the outermost are half again as long as the proximal width; the distal dorsal edge of the outer segments is slightly thickened.

Genus CRINOMETRA A. H. Clark

Comatula (part) Pourtalès, Bull. Mus. Comp. Zool., vol. 1, No. 6, 1868, p. 111.

Antedon (part) Pourtalès, Bull. Mus. Comp. Zool., vol. 1, No. 13, 1869, p. 357, and following authors.

Actinometra (part) P. H. Carpenter, Bull. Mus. Comp. Zool., vol. 9, No. 4, 1881, p. 162.

Spinifera group (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 212.

Granulifera group (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 241.

Brevipinna group Minckert, Arch. Naturg., Jahrg. 71, vol. 1, Heft 2, August 1905, p. 224 (definition; represented by *Antedon brevipinna* only).

Charitometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361.

Crinometra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 22 (diagnosis; genotype *Comatula brevipinna* Pourtalès, 1868), p. 144 (ornamentation compared with that of *Mariametra*); Vid. Medd. Nat. Foren. København, 1909, p. 147 (agrees in the variation in the IIBr series with *Pachylometra* its East Indian representative); Proc. U. S. Nat. Mus., vol. 40, 1911, p. 10 (represents in the West Indies the East Indian *Pachylometra* and *Glyptometra*); Crinoids of the Indian Ocean, 1912, p. 13 (corresponds to the East Indian *Pachylometra* and *Glyptometra*), p. 24 (range in detail; for zoogeographic purposes may well be considered as one with *Pachylometra* and *Glyptometra*).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 286 (discussion).—A. H. Clark, Internat. Rev. Gesamt. Hydrobiol. und Hydrogr., 1914, pp. 4 and following (represents *Pachylometra* and *Glyptometra* in the Atlantic; range and its significance); Die Crinoïden der Antarktis, 1915, p. 181 (range; represents in the Atlantic the Indo-Pacific *Pachylometra* and *Glyptometra*).—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Pap. 90–L, 1915, p. 195 (inorganic constituents of the skeleton); Prof. Pap. 102, 1917, pp. 23 and following (same).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 171 (in key; range), p. 186 (discussion, with list of included described forms); Journ. Washington Acad. Sci., vol. 9, No. 5, 1919, p. 136 (arm bases compared with those of *Holopus*); Univ. Iowa Studies in Nat. Hist., vol. 9, No. 5, 1921, p. 12 (confined to the West Indies), p. 19 (in key).—F. W. Clarke and Wheeler, U. S. Geol. Surv. Prof. Pap. 124, 1922, p. 20 (inorganic constituents of the skeleton).—A. H. Clark, The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range), p. 51 (in key).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 231 (irregular division series).—Pelseneer, Bull. Soc. Zool. France, vol. 53, 1928, p. 173 (parasitized by *Eulima* [*Sabinella*], sp.).—Gislén, Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, pp. 480–482; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 23, 25, 29.

Diagnosis.—A genus of Charitometridae in which the genital pinnules taper evenly from the usually more or less broadened earlier segments to a delicate tip, the portion beyond the gonad being much longer than the gonad itself; the division series and arm bases are rounded dorsally, with or without a fine abruptly raised median line and a tubercular ornamentation on the division series and arm bases; and the oral pinnules are markedly longer than the genital and distal pinnules, which are unusually short.

Geographical range.—From the Yucatán Bank, the Florida Keys, northern Cuba, and the southern Bahamas eastward and southward along the Antillean chain to Barbados and Grenada; also St. Helena.

Bathymetrical range.—From 139 to 707 meters.

Thermal range.—From 8.33° to 18.20° C.

History.—The first description of a species of this genus was by Count L. F. de Pourtalès who in 1868 referred it to the genus *Comatula*, transferring it to *Antedon* in the following year. It was referred to *Actinometra* by Dr. P. H. Carpenter in 1881, but transferred to *Antedon* in 1883. In his memoir on the comatulids of the *Challenger* Expedition published in 1888 Carpenter placed different forms of the species in his *Spinifera* and *Granulifera* groups of *Antedon*, and in 1905 Minckert established the *Brevipinna* group for it.

In my revision of the genus *Antedon* published in 1907 I transferred it to the new genus *Charitometra*, and in 1909 established the genus *Crinometra* with *Comatula brevipinna* Pourtalès, 1868, as the genotype. In 1933 Prof. Torsten Gislén discussed the genus *Crinometra* at considerable length and redefined it.

CRINOMETRA BREVIPINNA (Pourtalès)

PLATE 30, FIGURE 90; PLATE 31, FIGURE 93

Comatula brevipinna POURTALÈS, Bull. Mus. Comp. Zool., vol. 1, No. 6, 1868, p. 111 (off Havana, 270 fathoms; *Corwin*).—P. H. CARPENTER, Trans. Linn. Soc. (Zool.), ser. 2, vol. 2, 1879, p. 29 (unable to place it in *Antedon* or *Actinometra*).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 313 (original description republished).

Antedon brevipinna POURTALÈS, Bull. Mus. Comp. Zool., vol. 1, No. 13, 1869, p. 357 (not obtained since 1867).—P. H. CARPENTER, Proc. Zool. Soc. London, 1882, 1883, p. 746 (specific formula); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 212 (in key), p. 378 (locality).—HARTLAUB, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (systematic and bathymetrical relationships).—MINCKERT, Arch. Naturg., Jahrg. 71, 1905, vol. 1, Heft 1, pp. 169 and following (syzygies; regeneration).—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, pp. 1578, 1581 (listed).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 311 (*Blake* stations 34, 45, 101, 157, 158, 193, 198, 219, 232, 241, 249, 259, 269, 272; *Blake*, without locality; *Investigator*, apparently off Martinique; *Corwin* station 2), pl. 1, figs. 17, 18, 21–23; pl. 3, figs. 1, 3, pl. 4, figs. 1, 2, 5–7, pl. 11, figs. 1–9, pl. 12, figs. 3–5.—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).

Antedon granulifera POURTALÈS, Bull. Mus. Comp. Zool., vol. 5, No. 9, 1878, p. 215 (description; *Blake* station 45).—BELL, Proc. Zool. Soc. London, 1882, p. 533 (listed).—P. H. CARPENTER, Proc. Zool. Soc. London, 1882, 1883, p. 746 (corrected specific formula); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 239 (type of the *Granulifera* group; discussion), p. 241 (in key), p. 380 (Caribbean Islands, 101–120 fathoms [*Blake* stations 45 and 157]).—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1582 (listed).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 298 (redescription of the type specimen; notes; *Blake* stations 45, 34, off Martinique, "Steamer *Enterprise*, Capt. Cole"), pl. 1, figs. 24, 25, pl. 5, figs. 1–13, pl. 12, figs. 1, 2, 6–8.—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).

Actinometra granulifera P. H. CARPENTER, Bull. Mus. Comp. Zool., vol. 9, No. 4, 1881, p. 162 (discussion).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No, 4, 1912, pp. 298, 299 (synonym of *Antedon granulifera*).

Antedon pourtalesii VON GRAFF, Bull. Mus. Comp. Zool., vol. 11, No. 7, 1883, p. 129 (*Blake* station 241; myzostomes); *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 14, 18 (myzostomes), p. 38 (*Blake* station 241; myzostomes).—BRAUN, Centralbl. Bakteriol. und Parasitenkunde, vol. 3, 1888, p. 185 (myzostomes; after von Graff).

Antedon pourtalèsi P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 212 (in key), p. 379 (Caribbean Islands, 124–262 fathoms).—HAMANN, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1581 (listed).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 280 (=*brevipinna*), p. 309 (in *Spinifera* group; history; synonym of *brevipinna*).—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).

Brevipinna group MINCKERT, Arch. Naturg., Jahrg. 71, vol. 1, Heft 2, August 1905, p. 224 (definition; represented by *Antedon brevipinna* only).

Charitometra brevipinna A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed); vol. 52, part 2, 1908, p. 227 (compared with *Ch. smithi*).

Charitometra granulifera A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 298 (in synonymy of *Antedon granulifera*).

Charitometra pourtalesi A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed).

Charitometra imbricata A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 266 (new name for

Antedon granulifera P. H. Carpenter, 1888, [erroneously] supposed not of Pourtalès, 1878), fig. 3 (three consecutive pinnules on the same side of an arm); Smithsonian Misc. Coll., vol. 52, pt. 2, 1908, p. 227 (compared with *Ch. smithi*).—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).

Pachylometra imbricata A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 22 (listed).

Pachylometra brevipinna A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 22 (listed).

Crinometra brevipinna A. H. CLARK, Vid. Medd. Naturhist. Foren. København, 1909, p. 146 (supposed variation in the IIBr series really nonexistent).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 311 (in the synonymy of *Antedon brevipinna*).—A. H. CLARK, The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range); Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 658 (off St. Thomas; 240 fathoms).—GISLÉN, Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 481.

Crinometra pulchra A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 644 (description; *Albatross* stations 2319–2350).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 322, footnote (=*Antedon brevipinna* var. *pourtalesi*, pl. 4, fig. 1, according to A. H. Clark).—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (listed); Bull. U. S. Nat. Mus., No. 82, vol. 1, pt. 2, 1921, fig. 682, p. 338.—GISLÉN, Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 481; Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 20, 25, 26.—H. L. CLARK, Mem. Soc. Cubana Hist. Nat., vol. 15, No. 1, May 1941, p. 10 (*Atlantis* station 3326; notes).

Crinometra margaritacea A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 645 (description; *Albatross* station 2154); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (listed); Bull. U. S. Nat. Mus. No. 82, vol. 1, pt. 2, 1921, fig. 683, p. 339.—GISLÉN, Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 25.

Crinometra concinna A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 646 (description; *Albatross* station 2324).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 331, footnote (=*Antedon brevipinna* var. *elegans* according to A. H. Clark).—F. W. CLARKE and W. C. WHEELER, U. S. Geol. Surv. Prof. Pap. 90–D, 1914, pp. 34 and following (inorganic constituents of the skeleton); Prof. Pap. 102, 1917, pp. 20 and following (same).—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (listed); Bull. U. S. Nat. Mus. No. 82, vol. 1, pt. 2, 1921, fig. 678, p. 338.—F. W. CLARKE and W. C. WHEELER, U. S. Geol. Surv. Prof. Pap. 124, 1922, p. 17 (*Albatross* station 2324; inorganic constituents of the skeleton).—GISLÉN, Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 20, 24, 25.

Crinometra insculpta A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 646 (description; *Albatross* station 2753); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (listed); Bull. U. S. Nat. Mus., No. 82, vol. 1, part 2, 1921, figs. 680, 681, p. 338; The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range).—GISLÉN, Vid. Medd. Dansk. Nat. Foren., København, vol. 93, 1933, pp. 480, 481; Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 20, 30.—H. L. CLARK, Mem. Soc. Cubana Hist. Nat., vol. 15, No. 1, May 1941 p. 10 (*Atlantis* stations 2950, 2980, 2980A, 2980B, 2982A, 2982B, 2982C, 2983, 2983A, 2984, 2987, 2999, 3000, 3303, 3326, 3372, 3388, 3425, 3430, 3431, 3432, 3434, 3435, 3436, 3438, 3466, 3467, 3478, 3482).

Crinometra gemmata A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 647 (description; *Albatross* station 2330).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 298 (in synonymy of *Antedon granulifera*), p. 300 (pl. 5, fig. 9 [*granulifera*] is this species according to A. H. Clark).—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (listed); Bull. U. S. Nat. Mus. No. 82, vol. 1, part 2, 1921, fig. 679, p. 338; The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range).—GISLÉN, Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 26.

Antedon angusticalyx HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 287 (description; *Blake* station 157 [2; these are the specimens upon which Carpenter's depth record of 120 fathoms given in 1888 is based]), pl. 4, figs. 3, 4, pl. 12, fig. 9, pl. 13, fig. 2.—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).

Antedon brevipinna var. *decora* HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 322 (in key), p. 324 (description; St. Vincent; *Blake* stations 34, 158, 157), pl. 11, figs. 4, 9.—A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).—Gislén, Vidensk. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 480.

Antedon brevipinna var. *gracilis* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 322 (in key), p. 328 (description; *Blake* station 157), pl. 12, fig. 3.—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).—Gislén, Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 480.

Antedon brevipinna var. *pulchra* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 322 (in key), p. 329 (description; no locality).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).

Antedon brevipinna var. *elegans* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 322 (in key), p. 331 (description; *Blake* station 193), pl. 4, fig. 7, pl. 11, fig. 5.—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).—Gislén, Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 481.

Antedon brevipinna var. *tuberosa* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 322 (in key), p. 333 (description; no locality; *Blake* stations 219, 198), pl. 11, fig. 3.—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).—Gislén, Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 480.

Antedon brevipinna var. *diadema* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 337 (description; *Blake* station 101).—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).—Gislén, Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 481.

Antedon brevipinna var. *pourtalesi* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 339 (*Blake* station 219), pl. 4, fig. 1.

Antedon brevipinna var. *laevis* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 343 (description; no locality), pl. 11, fig. 8.—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).

Antedon brevipinna var. *spinosa* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 343 (description; no locality), pl. 11, fig. 8.—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).

Antedon brevipinna var. *coronata* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 345 (description; *Blake* stations 241, 272, 219), pl. 11, fig. 7.—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).

Antedon brevipinna var. *ornata* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 348 (description; *Blake* station 249), pl. 4, fig. 6, pl. 12, fig. 4.—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).

Antedon brevipinna var. *granulosa* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 351 (description; *Blake* station 45), pl. 11, figs. 1, 2.—A. H. Clark, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 187 (referred to *Crinometra*).

Crinometra gracilis H. L. Clark, Univ. Iowa Bull. Lab. Nat. Hist., vol. 7, No. 5, 1918, p. 10 (Bahama Exped. station 2; notes).

Crinometra ornata H. L. Clark, Univ. Iowa Bull. Lab. Nat. Hist., vol. 7, No. 5, 1918, p. 11 (Bahama Exped. stations 9, 16; notes).

Crinometra coronata A. H. Clark, Univ. Iowa Studies in Nat. Hist., vol. 9, No. 5, 1921, pp. 9, 11 (occurrence at Barbados; from Hartlaub).

Crinometra mortenseni A. H. Clark, U. S. Nat. Mus. Bull. 82, vol. 1, pt. 2, 1921, figs. 535, 536 (pinnule tips), p. 287.

Crinometra granulifera A. H. Clark, The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range).—Gislén, Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 481.—H. L. Clark, Mem. Soc. Cubana Hist. Nat., vol. 15, No. 1, May 1941, p. 9 (*Atlantis* stations 2999, 3303, 3465, 3478, 3482).

Crinometra imbricata Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, pp. 22, 23.

Crinometra transversa Gislén, Vid. Medd. Dansk Nat. Foren. København, vol. 93, October 26, 1933, p. 478 (description; comparisons; St. Helena, 280–360 meters, and ?480 meters), pl. 23, figs. 1–4, ?text fig. 5, p. 482.—Gislén, Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 29.

Description.—The usual form of this species as it occurs off northern Cuba may be described as follows: The centrodorsal is broad and discoidal with the broad dorsal pole more or less stellate and studded with small tubercles; the sides show five more or less pronounced interradial ridges. The cirrus sockets are arranged in 10–15 more or less irregular columns, usually 2 or 3 to a column.

The cirri are XX–XXX, 15–19, about 30 mm. long. The first segment is short, the second is about twice as broad as long, the third is about as long as broad, and the fourth and fifth are about half again as long as broad; the following segments gradually decrease in length, becoming distally about as long as broad. The third and one or two of the following segments have a more or less prominent constriction in their distal half, causing them to appear somewhat "dice-box shaped." The remaining segments have a slight prominence of the distal ends and a strong dorsal overlap. The dorsal profile of the distal half of the cirri is strongly serrate, although dorsal spines are not developed. The distal dorsal edge of the segments is sometimes furnished with a low ridge or a pair of low tubercles, one on each side. The opposing spine is well developed. The terminal claw is about as long as the penultimate segment, stout, and moderately curved.

The ends of the basal rays are visible as very irregular tubercles in the angles of the calyx.

The radials and most, or even all, of the IBr_1 are concealed. The IBr_1 when visible are very short and bandlike. The IBr_2 (axillaries) are low-triangular, two and one-half to three times as broad as long. Both ossicles are thickly covered with a mass of very irregular more or less confluent tubercles and blunt spines which often renders the delimitation of the ossicles a matter of some difficulty. In the median line there is a very irregular keel or a line of somewhat larger tubercles. The IIBr series are either 2 or 4(3+4), or both in varying proportions in the same individual. They have the same ornamentation as the IBr series. IIIBr 2 series are usually present resembling the IIBr series and developed internally in 1,2,2,1 order. The division series and first three brachials are in close apposition and sharply flattened laterally.

The 15–30 (usually 21–30) arms are 120–160 mm. long. The first brachial has a large median tubercle and a more or less tubercular dorsal surface. The second brachial is somewhat less rough. The third brachial is smooth except for the median tubercle, with the distal edge prominently everted and coarsely tubercular. The following brachials as far as the tenth are similar but with the median tubercle less marked and the coarsely tubercular character of the distal edge more accentuated. The first 10 brachials are oblong, about twice as broad as long, those following becoming wedge-shaped, longer than broad, with the distal edges strongly overlapping and bluntly serrate. After the proximal third of the arms the brachials become triangular, and distally wedge-shaped again and somewhat elongate. The basal third of the arm is somewhat compressed laterally.

Syzygies occur between brachials 3+4 (or 1+2, rarely 2+3, after a 4[3+4] series), again in the vicinity of brachials 25+26, and distally at intervals of 6–14 (usually about 8) muscular articulations.

P_D (when present) is 12 mm. long with about 30 short compressed segments of which the first six are about twice as broad as long and strongly flattened exteriorly and those following gradually become about as long as broad; the edges of the segments and more or less of the dorsal surface are studded with numerous fine spines. P_1 and P_2 are similar, 10–11 mm. long with about 21 segments of which the first two or three are short, those following about as long as broad, and those in the outer half of the pinnule elongate; the lower segments have roughened or more or less finely spinous edges, and the distal are never more than twice as long as broad. These three pinnules are moderately slender and taper gradually from the base to a slender and delicate tip. P_D is slightly larger than the others. P_3 is somewhat stouter than P_2, especially in the distal half, with about 18 segments of which the first three are short, the next three about as long as broad and somewhat broadened, the remainder gradually tapering and becoming elongate. The following pinnules to about P_{10} are similar but somewhat shorter. The distal pinnules are about 8 mm. long with about 15 segments of which the first is almost triangular, the second is irregularly trapezoidal, those following are about as long as broad, becoming distally from half again to twice as long as broad.

The disk is completely covered with a pavement of small plates. The brachial and pinnule ambulacra are bordered with well developed side and covering plates. Sacculi are abundant, but small and inconspicuous.

The color in alcohol is yellowish white, the division series and first three brachials brown. Presumably in life the color is bright yellow with the division series and arm bases brownish or olive.

Notes.—Although this description covers in a general way a large proportion of the individuals that have been dredged in the Caribbean area, and especially about Cuba, it is by no means adequate for the species as a whole, for this is perhaps the most variable comatulid known. There is no fixed pattern in its ornamentation, which varies from highly developed, coarsely tubercular or spinous, to completely absent; in the form of the division series, which vary from almost flat, with or without water pores, to strongly and evenly convex; in the composition of the division series, which may be all 2 or all 4(3+4), or both in any combination; in the cirri, which vary from short with short segments to more or less elongate with long segments; in the pinnules; or in other features usually assumed to be reasonably constant in any single species.

Many of the forms are so very widely different from others—as *angusta, gemmata,* and *insculpta*—that it seems at first sight impossible to regard them as representing the same species; but they are all interconnected in such a way that any attempt to separate them specifically is wholly impracticable.

In his most excellent review of this species published in 1912 Dr. Clemens Hartlaub said that the imposing number of fully, or at least almost fully, developed individuals upon which he based his treatment of *brevipinna* in part bore specific determinations in Carpenter's handwriting. In addition to these, he referred to *brevipinna* two specimens which Carpenter had determined as representing a distinct species, *pourtalèsi.* The larger of the two Hartlaub regarded as the sole representative of Carpenter's *pourtalèsi,* referring the smaller to his new variety *coronata.*

He remarked that since the original description of *brevipinna* was based upon a single juvenile specimen, it is naturally inadmissible as a diagnosis of the species, for a diagnosis based upon a study of medium sized and large specimens would be entirely different. A comprehensive account of the characteristics of the species seemed to him scarcely possible, and in view of the variability of almost all the characters it seemed to him necessary, in order to portray the species adequately, to establish a large number of varieties.

He emphasized the fact that in his attempt to determine the diagnostic characters of the species his account is to be regarded as couched only in general terms and applicable to the majority of, but not all, the individuals.

In his attempt to determine some of the characters of the species Hartlaub said that the centrodorsal is often flat with a prominant incised dorsal pole, which is usually ornamented. Interradial processes are present, but interradial ridges are rarely developed.

The number of cirri is very different in the different varieties, ranging between XV and XL. The number of cirrus segments varies from 12 to 20. The antepenultimate segment bears an opposing spine. The cirri are relatively short.

The radials are not visible. The elements of the IBr series are usually flattened dorsally. The IBr axillaries as a rule lack a proximally directed process. The IIBr series are either 2 or 4(3+4). The ossicles from the IBr axillary to the fourth or fifth brachial are in close lateral contact and sharply flattened laterally. The basal ornamentation, which is always different from the ornamentation of the arms, as well as the darker color, if present, also does not extend beyond the fourth or fifth brachials.

There is often a striking lateral compression of the arms. In regard to the lower brachials, a dual form is often conspicuously evident; the first few brachials (about 3) are quadrangular, with parallel edges and right angles; these are followed by a few (about 4) bluntly wedge-shaped brachials; then there are a few (usually 2) quadrangular brachials; following these, often quite abruptly, are triangular brachials that persist to the arm tips. Corresponding to the shape of the brachials, the articulations cross the arm either transversely or diagonally.

The first syzygy is between brachials 1+2 or 3+4, and there may be a syzygy in both positions so that an arm begins with two syzygial pairs. The position of the following syzygies is inconstant in the same individual, and in different individuals so very variable that this point must be considered in the accounts of the different varieties.

The length of P_D and of P_1 is very variable, according to Hartlaub, the size of the individuals naturally playing a certain part in this. The length of P_D varies between 8 and 17 mm., that of P_1 between 6 and 12 mm. The number of segments in these pinnules is also variable, though in this the size of a given variety seems not to play a significant part. The number of segments in P_D varies between 30 and 40, in P_1 between 20 and 40; in P_1 there are usually 20–30 in the individual varieties. The segments of these pinnules are short, the basal always more or less singly or doubly carinate. Generally speaking, the following pinnules decrease gradually in length and in the number of their segments, in both these features attaining a certain degree of uniformity in the middle of the arms. The pinnules in the middle of the arms are 3–7 mm. long with 7–13 segments of which the two first are, as a rule, short and broad and the remainder elongate. Toward the ends of the arms in all the varieties the length of the pinnules increases. When gonads are developed the few segments covering them (about 3) are broadened. The ambulacral plating is always very prominent and consists of side and covering plates.

The disk is usually flat and is often deeply incised.

Hartlaub said that except for two specimens, representatives of the varieties *gracilis* and *diadema*, the arms of alcoholic examples are never pure white, but grayish or brownish white; the division series and arm bases are often darker colored.

According to Hartlaub, the best diagnostic feature of the species is the qualitative as well as quantitative degree of development of the ornamentation. The ornamentation consists of tubercles, granules, teeth, or spines, or lips, or flanges, all appearing in manifold forms and on various places on the ossicles. On the centrodorsal fine ornamentation is found on the bare dorsal pole, between the cirri and also on their first segments, and on the interradial processes. On the division series numerous variations in the occurrence of the ornamentation are to be seen. The ornamentation is sometimes uniformly distributed over the surface of the ossicles, sometimes confined to their borders, which are often crenulate or dentate, and sometimes confined to a median ornament which may take the form of a ridge, a tubercle, or a row of tubercles. The ornamentation of the arms is confined to the first 10–12 brachials, usually beginning with the third and reaching to the tenth, twelfth, fifteenth, or twentieth. The remainder of the arms is smooth. For the most part the ornamentation of the arms is confined to the distal edge of the brachials which may be swollen and thickened, or simply raised and erect, or turned proximally or recurved into a kind of lip; sometimes this modification of the distal edge is smooth, sometimes ornamented—tubercular, dentate, or spiny. The ornamentation of the distal edges of the brachials appears in numerous variations so that the differentiation of individual varieties is thereby facilitated.

Hartlaub said that on the basis of the relative richness of the ornamentation, and taking into consideration the type of branching of the postradial series, it is possible to recognize definite varieties. He remarked it is evident that in the arrangement of these varieties other attributes and aspects are also significant; he supplemented his descriptions of the individual varieties by careful description of these features.

Among the specimens that Hartlaub assigned to *brevipinna* he distinguished three varietal types on the basis of the main ornamentation—that is, on the basis of the size and number of ornaments each characteristically showed. These three types were: (1) *Tuberosa* type, characterized by tubercular, humplike, knobby, or ridgelike ornamentation—that is, blunt ornamentation; (2) *Spinosa* type, characterized by spiny or jagged ornamentation with pointed or sharp ends to the various processes; (3) *Granulosa* type, represented only by a single variety characterized by granular, flat, and rounded prominences. Hartlaub said it should be noticed that the forms of the *Spinosa* and *Granulosa* types may be considered as transitions to *granulifera*, which he considered as specifically different from *brevipinna*; this point he discussed further under the varieties concerned.

Hartlaub undertook to present a survey of the varieties of *brevipinna* on the basis of the ornamentation of the postradial series. But he pointed out that several of these varieties were represented by a few specimens, or even by only a single one, so that on the basis of the material available to him he was unable to say how constant they are. He said that in this respect the best of all is var. *insculpta* (=*decora*), represented by 7 specimens, which appeared to him to be rather well characterized. In any case, he said, it should be emphasized that the resolution of *C. brevipinna* into a series of varieties is the only way to present a serviceable description for the recognition of such varied specimens.

Hartlaub remarked that it would have been easy to make new species out of one, or some, of the varieties, new species which would have been no more poorly based than many established by Carpenter, as for instance, his *pourtalèsi*, but in view of the great variability of almost all the characters he decided not to do this. He said that I had already done this in part, as in December 1909 I had written him that his figure 1 on plate 4 (*Antedon brevipinna* var. *pourtalèsi* from *Blake* station 219) is the same as my *Crinometra pulchra*, and his figure 7 on the same plate (*Antedon brevipinna* var. *elegans* from *Blake* station 193) is the same as my *Crinometra concinna*.

Greater familiarity with the genus *Crinometra* has shown me the correctness of Hartlaub's conclusions regarding *C. brevipinna*. Indeed, he did not go far enough. The two specimens from *Blake* station 157 that he recorded and described under the name of *Antedon angusticalyx* (=*Perissometra angusticalyx*) are in no way distinguishable from unornamented varieties of *brevipinna* with the IIBr series 4(3+4). These two specimens are herein referred to *brevipinna* var. *angusta*, var. nov.

Hartlaub mentioned several specimens that seemed to him to be intermediate between *brevipinna* and *granulifera*, which he regarded as a distinct species though he failed to give its differential characters. Since he described *granulifera* (and *angusticalyx*) in Carpenter's *Granulifera* group and *brevipinna* in Carpenter's *Spinifera* group a natural inference is that he considered *granulifera* to be characterized by having the IIBr series 4(3+4) while in *brevipinna* the IIBr series are 2. But in *Crinometra* this difference is of no significance. Indeed, in one of Pourtalès' type specimens there are three IIBr 2 and two IIBr 4(3+4) series; in another all five IIBr series are 4(3+4); and in the third the IIBr series are 4, with the two outer elements not united by syzygy. I am therefore placing Pourtalès' *Antedon granulifera* in the synonymy of *brevipinna* and referring to *brevipinna* the two much broken specimens from *Blake* station 45 (the type locality of *granulifera*), the two from *Blake* station 34, and the two from Martinique described under *granulifera* by Hartlaub.

In the following pages there are recognized 19 varieties of *Crinometra brevipinna*. Few, if any, of these represent fixed and stable types. All that are adequately known are subject to more or less wide variation by which they approach, or intergrade with, one or more other varieties.

It appears to be generally true that all or most of the individuals from a single dredge haul during which there was no appreciable alteration of depth or temperature will be very similar and will show certain features in common by which they differ from those from other dredge hauls. In other words, they represent inbred family groups, or groups showing a more or less definite correlation with their environment.

These recognized varieties vary in significance all the way from fairly well characterized and stable types, like *insculpta*, *gemmata*, and *pulchra* to mere individual variants some of which appear to be nothing more than undeveloped individuals of more elaborately ornamented varieties. Much light will be shed on this subject when the 288 specimens secured by the *Atlantis* in Cuban waters in 1938 and 1939 have been studied.

The type specimen of *brevipinna* is a young individual with the varietal characters not yet fully developed so that it cannot properly be allocated, and the specimens described as *brevipinna* by Hartlaub are all similarly young and undeveloped. All that can be said about them is that they appear to belong to at least two varieties.

It is by no means always possible to identify a given specimen with one or other of these varieties, for it may be intermediate between two of them, or it may represent another variety quite as good as some of those listed—which are merely those to which names have been applied.

The 19 varieties of *Crinometra brevipinna* herein recognized fall into four types which when typically developed are quite distinctive, but which intergrade to a greater or lesser extent. These four types, with the included varieties listed roughly according to the increasing specialization of their distinctive characters, are:

1. *Pulchra* type; division series and arm bases smooth, without ornamentation; 219–562 meters; temperature 15.33° C. (*angusta, pulchra*). The varieties *angusta* and *pulchra* are probably only alternative forms of the same variety, with the IIBr series either 4(3+4) (*angusta*) or 2 (*pulchra*).
2. *Granulosa* type; ornamentation of the division series and arm bases consisting of rounded or flattened granules, either confined to the borders of the ossicles or generally distributed; 185–475 meters; temperature 16.53° C. (*granulifera, granulosa*). The varieties *granulifera* and *granulosa* are probably only alternative forms of the same variety, with the IIBr series either 4(3+4) (*granulifera*) or 2 (*granulosa*).
3. *Spinosa* type; ornamentation of the division series and lower brachials consisting of sharp conical spines or sharp dentations; 139–479 meters; temperature 8.33°-18.20° C. (*ornata, coronata, gemmata, spinosa*). The variety *spinosa* is probably only an alternative form of the variety *gemmata* with the IIBr series 2 instead of 4(3+4).
4. *Insculpta* type; ornamentation of the division series and lower brachials consisting of blunt tubercles, knobs, or more or less broad rounded ridges; 159–567 meters; temperature 8.89°–16.67° C. (*brevipinna, pourtalèsi, diadema, margaritacea, tuberosa, transversa, concinna, pulchella, gracilis, insculpta*). This is Hartlaub's *Tuberosa* type renamed so as to avoid confusion with *Glyptometra tuberosa*.

From the standpoint of the conditions in the other genera in the family Charitometridae it appears most logical to regard the *Pulchra* type as the generalized stem type from which the others have been derived, and within the *Pulchra* type the variety *angusta* is more generalized than the variety *pulchra*.

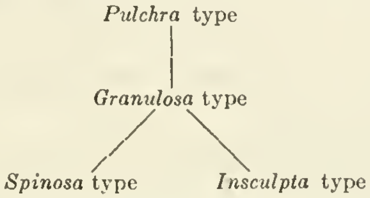
The *Pulchra* type passes insensibly into the *Granulosa* type.

From the *Granulosa* type there are two lines of development; the granules may elongate and become pointed, resulting in an ornamentation or more or less stout conical spines or dentations, such as characterize the *Spinosa* type; or the granules may become enlarged and elongated into blunt tubercles or ridges with rounded crests, such as characterize the *Insculpta* type.

In the family Charitometridae the IIBr series, when present, are usually 4(3+4), or in the majority of cases 4(3+4). In the *Pulchra* and *Granulosa* types IIBr series of 4(3+4) and 2 seem to be equally common. In the *Spinosa* type one variety, *gemmata*, has the IIBr series 4(3+4), the other three having the IIBr series 2. In the *Insculpta* type the IIBr series are in all the varieties 2, though in some a few of them may be 4(3+4).

The *Insculpta* type is an interesting parallel to the East Indian genus *Glyptometra;* while the *Spinosa* type includes the only spiny forms in the family Charitometridae, a more or less similar development of spines being characteristic of many forms in the allied family Thalassometridae.

The four varietal types in *Crinometra brevipinna* may be arranged in the order of their presumed development as follows:



The *Insculpta* type is much the commonest, and is the only type known to occur at St. Helena. In the Caribbean area all the types appear to be generally distributed, and on the basis of the meager data at present available there is no demonstrable difference in their bathymetrical and thermal relationships.

In the discussion of the several varieties the brief synonymy given is merely a key to the references given in the full synonymy under the specific name.

Under the varieties only the localities from which each is definitely known are given. The full data for these localities may be found by consulting the list of the localities at the end of the account of the species. This full list of localities includes many of the specimens that have not been allocated according to variety because they are too young to have developed the characteristic varietal features, or for other reasons.

KEY TO THE NAMED VARIETIES OF CRINOMETRA BREVIPINNA

a^1. Division series and arm bases with more or less developed tubercular, granular, or spinous ornamentation, at least along the borders of the ossicles.
  b^1. Ornamentation consisting of blunt tubercles, humps, knobs, rounded ridges, or granules, never of spines.
    c^1. In addition to the chief ornamentation there are small tubercular, dentate, or spiny excrescences, usually coalesced into lamellae, on the lateral borders of the division series and first three brachials.
      d^1. The fine lateral excrescences are highly developed; the lateral borders of the ossicles as far as the third brachial are strongly everted; median ornamentation of the ossicles of the division series mostly knoblike ---------- **insculpta** (p. 291)
      d^2. The lateral excrescences are qualitatively and quantitatively less developed; the lateral borders of the elements of the division series and first three brachials are only slightly everted; median ornamentation of the ossicles of the division series more humplike. **gracilis** (p. 296)
    c^2. No small excrescences on the lateral borders of the division series and lowest brachials.
      d^1. Lower brachials, beyond the arm bases, with thickened and usually produced and everted distal ends.
        e^1. Lower brachials beyond the basal with greatly produced distal edges which are turned proximally over the dorsal surface in the form of a lip.
          f^1. Proximally recurved liplike distal ends occur on the 5–10 brachials following the tenth; from the third, eighth, or tenth brachial strongly thickened distal ends are developed from the middle of which a smooth, often quadrangular, swelling or broad tubercle extends proximally downward over the dorsal surface.
            g^1. Entire surface of the elements of the division series thickly beset with equal sized and uniformly distributed usually blunt tubercles of moderate size, which may be coalesced; only exceptionally a larger shield-shaped median ornament. **pulchella** (p. 297)

g^2. A large median tubercle or median ridge on the elements of the division series, with small tubercles on the sides.

h^1. Beyond the IBr$_1$ only the borders of the elements of the division series carry small tubercles; a larger median tubercle or median ridge always present. **concinna** (p. 298)

h^2. In addition to the small tubercles, and beyond the always present large median tubercle, there are larger ones on the elements of the division series, which give the ornamentation a coarser character; there is no eversion of the distal ends; dentation occurs only on the proximal border of the axillary, which may be crenulate or pleated---------- **tuberosa** (p. 303)

f^2. Proximally recurved liplike distal ends are developed from the first to the fifth brachial and onward; the fifth to eighteenth or twentieth brachials have raised tubercular or almost dentate distal ends and a large knoblike median tubercle; from the ninth to the thirteenth brachials the distal ends are recurved proximally without being typically liplike---------- **diadema** (p. 308)

e^2. Lower brachials with only thickened, usually smooth, more rarely slightly crenulate or tubercular, distal edges which are not produced and turned downward.

f^1. Elements of the division series with strongly everted and more or less tubercular or crenulate margins and an abrupt and conspicuous median ridge; cirrus segments usually short, the longest half again as long as broad---------- **transversa** (p. 301)

f^2. Elements of the division series without prominently everted edges, with granular or beadlike ornamentation often confined to the edges; cirrus segments usually longer, the longest twice as long as broad.

g^1. Dorsal surface of the elements of the division series smooth, the lateral borders only slightly tubercular; a row of small beadlike tubercles on the proximal border of the IBr$_1$ and IBr axillary; IIBr 2.

h^1. Elements of the IBr series with an elevated midline and a sharp median ridge. **brevipinna** (p. 312)

h^2. Elements of the division series almost flat, with a low broad median swelling; no median ridge---------- **pourtalèsi** (p. 309)

g^2. Dorsal surface of the elements of the division series with more or fewer more or less flattened granules or small tubercles.

h^1. Dorsal surface of the division series with more or fewer large and more or less flattened granules that become smaller and higher on the lower brachials; usually a low and narrow median ridge.

i^1. IIBr 2---------- **granulosa** (p. 325)

i^2. IIBr 4(3+4)---------- **granulifera** (p. 326)

h^2. Dorsal surface of the division series evenly studded with more or less uniform moderately large rounded or blunt tubercles which become gradually less marked after the second brachial and disappear altogether at about the end of the proximal fourth of the arm; elements of the IIBr and IIIBr series and first two brachials with a low but prominent median carination continued on to the arms in the shape of a prominent median tubercle on each brachial which disappears at about the end of the proximal fourth of the arm----- **margaritacea** (p. 307)

d^3. Arms from the third brachial outward entirely smooth, the brachials without thickened distal edges; on the IBr axillary and the elements of the IIBr series the median ridge is sharply produced, resulting in an angular sharpening of the dorsal surface-- **laevis** (p. 311)

b^2. Ornamentation consisting of sharp pointed spines or teeth.

c^1. Ornamentation of the lower brachials and that of the division series equally well developed; the whole surface of the division series and lower brachials as far as the tenth or twelfth rather thickly and fairly evenly beset with spines or teeth.

d^1. IIBr 4(3+4)---------- **gemmata** (p. 318)

d^2. IIBr 2---------- **spinosa** (p. 316)

c^2. Ornamentation of the arm bases qualitatively and quantitatively more strongly developed than that of the division series.

- d^1. Division series with fine marginal ornamentation in the form of small spines, tubercles, or dentation; median ornamentation little developed; a row of spines or teeth on the distal edge of the first ten or twelve brachials---------------------------**coronata** (p. 320)
- d^2. Division series with coarse marginal ornamentation in the form of a coarse dentation; median ornamentation strongly developed; distal border of the first 10 to 17 brachials bristling with large spines and teeth, and the surface of the fourth-tenth brachials beset with small spines or teeth--**ornata** (p. 323)

a^2. Division series and arm bases wholly without ornamentation, strongly convex or subcarinate dorsally, the IBr axillary and the second segment beyond with more or less developed rounded posterior processes.

- b^1. Brachials from the third or fourth to about the thirty-fifth with conspicuously swollen and produced distal ends, the middle of which is swollen into a broad tubercle which may extend anteriorly to the proximal edge; IIBr series 2---------------------------**pulchra** (p. 334)
- b^2. Lower brachials without produced distal ends; IIBr series 4(3+4)---------**angusta** (p. 335)

CRINOMETRA BREVIPINNA var. INSCULPTA A. H. Clark

PLATE 32, FIGURE 99

[See also vol. 1, pt. 2, figs. 680, 681, p. 338.]

Crinometra insculpta A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 646 (description; *Albatross* station 2753).—H. L. CLARK, Mem. Soc. Cubana Hist. Nat., vol. 15, No. 1, 1941, p. 10 (*Atlantis* stations 2950, 2980, 2980A, 2980B, 2982A, 2982B, 2982C, 2983, 2983A, 2984, 2987, 2999, 3000, 3303, 3326, 3372, 3388, 3425, 3430, 3431, 3432, 3434, 3435, 3436, 3438, 3466, 3467, 3478, 3482).

Antedon brevipinna var. *decora* HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 322 (in key), p. 324 (description; *Blake* stations 34, 157, 158; also St. Vincent), pl. 11, figs. 4, 9.

Description.—The centrodorsal is flattened-hemispherical with the bare polar area 3 mm. in diameter, thickly covered with prominent small rounded tubercles. The cirrus sockets are arranged in two, or two and a partial third, very closely crowded and irregular rows.

The cirri are XX, 15–18, from 25 to 30 mm. long. The first segment is very short, the second and third are about twice as broad as long, the fourth is about as long as broad, the next four or five may be slightly longer than broad, and the remainder are about as long as broad; or the fourth and following may all be about as long as broad. The penultimate segment is twice as long as broad, slightly less in width than those preceding. The opposing spine is minute, terminally situated, directly obliquely forward. The terminal claw is about three-quarters the length of the penultimate segment, moderately slender and moderately and evenly curved. The segments have slightly thickened distal ends and the terminal six or seven have the distal part of the dorsal surface raised into a transversely broad tubercle with a more or less crenulate or serrate distal edge.

The ends of the basal rays are visible in the interradial angles as a cluster of high tubercles, with difficulty separable from the similarly modified surface of the surrounding elements.

The radials are concealed. The IBr_1 are very short, usually concealed except in the angles of the calyx. The IBr_2 (axillaries) are triangular, three or four times as broad as long. The IIBr series are 4(3+4) and 2, usually both in the same specimen, the former in the majority; when the IIBr series are 2 the ossicles are in close apposition along their entire lateral edges, no water pores being present. The IIIBr series are 2(1+2) following a IIBr 4(3+4) series, and 2 following a IIBr 2 series; they are developed internally. In the rare cases on which IIIBr series are developed externally they are either 4(3+4) or 4(1+2, 3+4). The full complement of IIIBr series is never present. The division series and lower brachials are slightly convex dorsally and are laterally in close apposition and sharply flattened. The elements of the IBr series are thickly and evenly covered with prominent tubercles resembling those on the dorsal pole of the centrodorsal. These sometimes arrange themselves in a linear series in the median line, or there may be a more or less distinct median keel which, however, is never well marked. This evenly tubercular ornamentation may encroach somewhat upon the lower elements of the IIBr series, and always extends for a considerable distance up into the interradial angles and also between the IIBr series, narrowing to a point distally. The elements of the IIBr and IIIBr series and the lower brachials have more or less—usually strongly—crenulate or tubercular edges, and their dorsal surface usually bears a few small scattered tubercles. Along the median line they bear large and prominent dorsoventrally elongate, narrow, dorsally rounded tubercles which form a conspicuous narrow carination.

The lower brachials have very strongly dentate or tubercular distal ends in the center of which is a single large tubercle. These brachial tubercles form a median line of tubercles along the arm that continues the carination of the division series out along the arms, where it gradually dies away and disappears at about the end of the proximal fourth. The prominent eversion of the distal edges of the brachials becomes distally less strongly dentate, at the same time becoming less and less erect, until at about the twentieth brachial it becomes merely a moderately marked finely spinous overlap and so continues to the end of the arms. The brachials as far as about the twentieth are sharply flattened laterally.

P_D is 13 mm. long, evenly tapering and becoming slender distally, with 30 segments which at first are about three times as broad as long, becoming about as long as broad distally; the first four or five segments are slightly carinate. P_1 is 14 mm. long, slightly more slender basally than P_D, with slightly longer segments which become about one-third again as long as broad distally; the lower segments are not carinate. P_2 is 13 mm. long. P_3 is 12 mm. long. P_4 is 11 mm. long, becoming progressively more expanded basally but tapering evenly and very slender in the distal half. The pinnules following still further decrease in length and increase in basal stoutness, P_7 being 8 mm. long with 15 segments of which the third, fourth, and fifth are expanded, the fourth most so, and the remainder are slender. For some time the pinnules are similar to P_7, after which they gradually lose the basal expansion and increase in length to 10 mm.

In alcohol the color is dull yellowish or light yellowish brown, the calyx and arm bases to the third brachial often dark yellowish brown.

Notes.—A much more detailed description of this form is based upon one specimen from St. Vincent without further data, one from *Blake* station 34, one from *Blake* station 158, and four specimens and fragments of a fifth from *Blake* station 157, under the name of *Antedon brevipinna* var. *decora.* The specimen from St. Vincent had an arm length of about 85 mm.; that from *Blake* station 34 an arm length of about 75 mm.; that from *Blake* station 158 an estimated arm length of 90 mm.; and the four from *Blake* station 157 had arms 65, 75, 80, and 85 mm. long.

The centrodorsal is very flat. The bare dorsal pole is flat, sharply delimited, bearing fine protuberances—small spines, tubercles, or teeth, in part isolated though as a rule united into sinuous bands—which are closely set and dark colored. Spiny and tubercular protuberances are also found between the cirri, and on the interradial processes which generally speaking are not especially produced. Here and there small teeth and spines are found also on the first cirrus segments. The cirri are usually arranged in pairs, one above the other.

The cirri are about XX, 14–18, always much lighter in color than the dark centrodorsal and division series. The two first segments are short, those following elongated; the antepenultimate bears an opposing spine.

In all the specimens the ornamentation of the bases of the postradial series is highly developed and very uniform. Abundantly developed fine dentate protuberances, mostly united into lamellae, cover the flat and more or less concealed IBr_1, and extend distally along the everted lateral edges of the ossicles as far as the third brachial. In proportion to the degree of their development, the lateral borders of these ossicles acquire a more or less crinkled appearance. The ornamentation of the dorsal surface of the ossicles is exceptionally developed. In addition to the protuberances mentioned, which are distributed over its dorsal surface, the IBr_1 usually bears a few white tubercles among which a median tubercle is usually noticeable because of its greater size. The IBr_2 (axillaries) and the ossicles of the IIBr and IIIBr series bear on the dorsal surface several light colored, often knoblike, tubercles and teeth which in part are coalesced into swellings. In the median line there is a large tubercle, or several which together may form a tubercular longitudinal ridge. On the IIBr axillary and on the IIIBr series and first two brachials, the tubercles often move to the distal edge, which then appears greatly produced. Otherwise the distal and proximal borders of these ossicles are not conspicuously raised, but are usually beset with sharp teeth and spines which are especially well developed at the articulations between the elements of the IBr series. From the IBr axillary to the fourth brachial the ossicles are in very close lateral contact, with sharply flattened sides. Like the centrodorsal, these ossicles are dark colored.

In all Hartlaub's specimens the radials are entirely concealed, and the mostly concealed IBr_1 are also noteworthy. The IBr_2 (axillaries) are in general flat, more rhombic than pentagonal. Hartlaub noted that the number of the elements in the IIBr series is highly variable, not only in different specimens, but also in a single specimen. Thus the largest specimen, from *Blake* station 157, has two IIBr 2 series and six IIBr 4(3+4) series, in one of which there is an uncommonly close union between the first and second elements; two of the arms in this specimen arise from an IBr axillary.

In another specimen from the same station there are five IIBr 4(3+4) series and three IIBr 2 series. In a third there is one IIBr 1 series (consisting of a single axillary ossicle), four IIBr 2 series, and five IIBr 4(3+4) series. Both IIBr 2 and IIBr 4(3+4) series occur together in the specimen from *Blake* station 158, and in that from *Blake* station 34. In the specimen from St. Vincent all the IIBr series present are 4(3+4), but one is missing; this specimen possesses both IIIBr 2 and IIIBr 4(3+4) series.

In all the specimens the proximal brachials bear an exceedingly characteristic ornamentation. From about the third to about the fifteenth brachial the distal edges are liplike, turned outward and downward. They are not smooth, but slightly tubercular or somewhat pleated and markedly overlap the dorsal surface. At the syzygies there are two similar lips close together.

The disposition of the syzygies is variable, on different arms of the same specimen as well as in different specimens. The first two brachials may be united by syzygy or by a muscular articulation; in either case there may be a syzygy between brachials 3+4, more rarely between brachials 5+6. On one arm there are syzygies between both brachials 3+4 and 5+6. The next syzygy, whether a second syzygy is present or not, lies fairly constantly from about between brachials 13+14 to between brachials 20+21, most commonly between brachials 15+16 or 16+17. The following intersyzygial interval is from 4 to 14 muscular articulations, in most cases from 6 to 10.

Because of the regular presence of IIBr series the number of arms is as a rule 20, but as the arms are often broken Hartlaub could not determine this with certainty. Only the specimen from St. Vincent possesses more than 20 arms, and the largest from *Blake* station 157 has only 18. The proximal brachials are rectangular and broader than long; at about the fifth to the tenth the brachials become bluntly wedge-shaped, and at about the middle of the arm their dorsal surface is approximately triangular. The arms taper slowly distally.

The lowest pinnule on arms following the IBr axillary or a IIBr 2 series is P_1, on postradial series with the IIBr 4(3+4) it is P_D. P_D is about 8 mm. long with 30 segments of which about the first ten are unusually thick, broad, and carinate, and on the interradial side smooth in correlation with the sharply flattened sides of the IIBr series. The segments following are more slender and small. Here and there spines or teeth are found on the edges of the segments. P_D is dark colored as far as the dark color extends on the postradial series. On the two arms arising from a IBr axillary studied P_1 is somewhat longer than P_D and is composed of 34 segments of which the first ten are broad and flat; the pinnule tapers gradually; the fourth-seventh segments have a strikingly strong single keel. On arms arising from a IIBr axillary P_1 differs from the pinnule described. It is very variable in the form of the basal segments, not only in different specimens, but strikingly so on different arms of the same specimen. For instance, on the same postradial series one outer P_1 is 7 mm. long and has six broad proximal segments which in surface view appear heartshaped or approximately triangular with proximally directed points; a carination is scarcely suggested. The other outer P_1 is 6 mm. long with 10 much broader proximal segments of which the form is more quadrangular; its most striking feature is a typical double keel; the crests of the keels as far as the fifth segment on one side, thence on both sides, are beset with spines and teeth, or serrate. The small distal segments of the two pinnules are also different. Neither pinnule follows a P_D so that their positions are entirely comparable. Only in the majority of cases can the following be said of P_1. It is composed usually of 20–25 segments of which the 8–10 proximal, with the exception of the first, are doubly keeled, the crest of the carination being spiny or serrate on one or on both sides. The proximal segments are more closely united than in P_D, in which they follow each other rather closely. The small distal segments are sometimes more triangular, sometimes more rectangular. Proximally rather broad, P_1 tapers only gradually to a fine point. P_a and P_2 are in general shorter than P_1, usually 5–7 mm. long with 16–23 segments of which the edges are in part dentate or spiny. But there is marked variation in the length and in the number of included segments. The number of segments may vary as much as 10 in the same specimen, as for instance in the largest specimen from Blake station 157 in which P_a has from 17 to 27 segments. In the same specimen one P_2 is over 10 mm. long with about 35 segments and of the same length as P_1 on the same arm. In the specimen from *Blake* station 158 one P_a is barely 3 mm. long with 10 segments.

In the same specimen P_2 on another arm is abnormally short—3 mm. long with only 11 segments—shorter than P_3 of the same arm, which is 5 mm. long with 16 segments. The form of the broader proximal segments of P_a and P_2 varies, even in the same specimen. Sometimes the second-sixth segments are more triangular, sometimes more quadrangular. On some P_2 the third and fourth, or in addition the second and third, segments of one side have an especially long keel, a feature which in other pinnules of the same type is not evident. P_b and P_3 are generally somewhat shorter, 5–6 mm. long with 14–16 segments, and about 6 broad proximal segments of which the second-fourth or second-sixth are singly or doubly carinate, and the 8–10 outer are elongate and small; the crest of the keels may be either smooth or dentate. The pinnules following—P_c, P_4, and P_d—are on the average shorter, about 4–5 mm. long with 10–13 segments; in the form of the basal segments, in the number of their segments, and in their length, they form a transition to the pinnules of the brachials succeeding and the middle of the arm, up to about the fifteenth brachial. These pinnules are short; almost always two thick and broad basal segments may be recognized, followed by 7–10 elongated ones. This type of pinnule can be shown to be typical for the middle of the arm in all the specimens. Preponderating by far are pinnules 3 mm., seldom 4 mm., long with 9 segments; variants are pinnules with three broad basal segments, and others 5 mm. long with 11–12 segments. Toward the arm tips there appears to be no increase in the length of the pinnules, but because of the poor state of preservation of the arm tips Hartlaub was unable to make a definite statement in regard to this.

The ambulacral plating of the pinnules consists of well developed side- and covering-plates. The sacculi are rather small and inconspicuous. The disk is deeply incised, 8–10 mm. in diameter, brown in color.

In alcohol the centrodorsal and post-radial series as far as the third brachial are dark—brownish to brown—with the remaining brachials and the cirri white.

Localities.—*Blake* stations 34, 157, 158, also St. Vincent; *Albatross* stations 2161, 2752, 2753; *Atlantis* stations 2950, 2980, 2980A, 2980B, 2982A, 2982B, 2982C, 2983, 2983A, 2984, 2987, 2999, 3000, 3303, 3326, 3372, 3388, 3425, 3430, 3431, 3432, 3434, 3435, 3436, 3438, 3466, 3467, 3478, 3482; off St. Croix. For the details of these stations see page 339.

Geographical range.—From the Yucatán Bank, Cuba, and the southern Bahamas southward along the Antillean chain to St. Vincent.

Bathymetrical range.—From 267 to 548 meters.

Thermal range.—One record, 8.89° C.

Remarks.—Dr. H. L. Clark recorded 272 specimens of this form from the *Atlantis* stations given. It seems unlikely that all of these really belong to it; some of the other related forms surely should be represented in such extensive material. A detailed study of the *Atlantis* specimens is much to be desired.

Dr. Clark said that several of the specimens were still attached to the sponges upon which they apparently often live. Most of them still retained some trace of a bright yellow color which is very marked in many specimens and was apparently the normal color in life; in large specimens the calyx and base of the arms is darker and duller, an indistinctive gray-brown. Dry material is often more or less bleached, sometimes nearly white. The size of the specimens ranged from about 8–10 mm. across the disk, with arms 50 mm. long, more or less, to big adults 20–25 mm. across the disk with arms nearly or quite 200 mm. long. He said that there is no little diversity in the sculpturing and ornamentation of the calyx and arm bases, but on the whole the species characters (of *insculpta*) are well maintained.

CRINOMETRA BREVIPINNA var. GRACILIS (Hartlaub)

Antedon brevipinna var. *gracilis* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 322 (in key), p. 328 (description; Blake station 157), pl. 12, fig. 3.

Description.—This variety was described from a single specimen with the arms about 75 mm. long from *Blake* station 157.

Hartlaub said that at first sight this specimen is noteworthy by its slender habitus resulting from its long, narrow, and laterally compressed arms. There is no darkening of the centrodorsal and the postradial series. Except for the somewhat darker deeply incised disk it is, in alcohol, of a brilliant white color.

Its significant differences from var. *insculpta* (*decora*) are as follows. The very flat centrodorsal has fewer cirri with few segments, the cirri being XVI, about 12; the penultimate segment bears an opposing spine.

The fine lamellaelike protuberances are qualitatively and quantitatively less developed on the centrodorsal and on the only slightly everted lateral borders of the ossicles of the division series and first four brachials; similarly, the number of the tubercles or swellings on the division series and lower brachials is small; in contrast to var. *insculpta* (*decora*), there are here broad and large lumps and swellings. As a result, the division series have a far less rough appearance. The lips on the lower brachials are finer.

All the IIBr series are 2, and there is one IIIBr 2(1+2) series so that the number of arms is 21. Almost throughout, the first syzygy is between brachials 1+2 and the second between brachials 3+4, so that the arms begin with two syzygial pairs, except for the two arms arising from the IIIBr axillary in which the first syzygies are between brachials 5+6 and 8+9. In marked contrast to this is the sequence of syzygies in arms arising from the IIBr axillaries. The next syzygy is from between brachials 11+12 to between brachials 13+14, most commonly by far between brachials 12+13; the next is from between brachials 17+18 to between brachials 20+21, usually between brachials 19+20, and those succeeding follow most commonly at intervals of 5, 6, and 7, very rarely 8 and 10, muscular articulations. Thus the syzygies are characteristically close together.

P_1 is 6 mm. long with 20 segments of which usually only 4 and at the most 6 of the basal are broadened, with fully double or more strongly single keels. The pinnules succeeding, gradually decreasing from 5 to 4 and to 3 mm. in length to the eighth brachial, have moderately broadened proximal segments which are followed by elongate ones. The pinnules of the middle portion of the arms are about 3 mm. long with, as a rule, 10 segments of which the first two are short and the first is markedly broadened.

The ambulacral plating consists of side and covering plates. The sacculi are small and inconspicuous.

Locality.—*Blake* station 157.

Geographical range.—Known only from off Montserrat, British West Indies.

Bathymetrical range.—Recorded only from 219 meters.

CRINOMETRA BREVIPINNA var. PULCHELLA, var. nov.

Antedon brevipinna var. *pulchra* (not *Crinometra pulchra* A. H. Clark, 1909) Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 322 (in key), p. 329 (description; no locality; *Blake*).

Description.—Hartlaub regarded a very large specimen with rather slender and laterally compressed arms reaching about 150 mm. in length as a representative of a special variety. Unfortunately there was no locality label with it.

This variety differs from var. *gracilis* externally by its stouter habitus and the dark color of its centrodorsal which in places is almost black, and by the exceptionally light cirri and division series. The upper border of this dark color is very different on the several postradial series.

The form of the centrodorsal resembles that described for var. *insculpta* (*decora*). So does the ornamentation, which is composed of fine pointed protuberances coalesced into lamellae on the dorsal pole and on the sides of the centrodorsal. In contrast to var. *insculpta* and var. *gracilis*, these are confined to the centrodorsal.

The cirri are XXIV, all broken off beyond a few basal segments.

The ornamentation of the ossicles of the division series consists of uniformly large usually blunt tubercles which, closely placed and occasionally coalescing, rather uniformly cover the ossicles. Only very exceptionally is there a larger median tubercle or a median ridge. In contrast to var. *insculpta* the proximal, distal, and lateral borders of the segments are not distinguished by special ornamentation. On the surface of the ossicles of the IIIBr series and first four brachials there is found, in contrast to var. *insculpta*, a broader shield-shaped swelling or tubercle, besides which there are the small tubercles of the type found on the IBr and IIBr series. These last generally end at the fourth brachial. The radials are not visible. All the IIBr series are 2 and, like the IBr series, are flat. All the axillaries are rhombic. There is one IIIBr 2 series.

There are 21 arms. The ornamentation of the brachials from the third outward to about the tenth differs from that characteristic of var. *insculpta* and var. *gracilis* in that a larger, smoother, and approximately quadrangular tubercle or swelling arises from the lower edge of the swollen distal border of the brachials in the middle of their dorsal surface. As far as about the tenth brachial the form of the rather flat ossicles is rectangular with transverse articulations. After the tenth the brachials assume a more diagonal direction, the brachials rather suddenly becoming approximately triangular and longer and at the same time developing a liplike ornamentation, the median tubercles disappearing and the produced and slightly crenulate or tubercular distal edge being turned downward in the middle.

In contrast to var. *insculpta* and var. *gracilis*, there is never a syzygy between brachials 1+2. The first syzygy is usually between brachials 3+4, very rarely between brachials 4+5. In the two arms arising from the IIIBr series the first syzygy is between brachials 18+19 and 27+28. The syzygy between brachials 3+4 is followed very rarely by one between brachials 6+7; as a rule the second syzygy, as in var. *insculpta*, is from between brachials 12+13 to between brachials 21+22; the next occurs after an interval of from 8 to 11, usually 8, muscular articulations, and the distal intersyzygial interval is from 6 to 13, usually 7–9, muscular articulations.

P_1 is about 10 mm. long with 25–30 segments of which the first 5 or 6 are markedly broadened and narrowly carinate on both sides. The pinnules following as far as P_4 are somewhat—about 1 mm.—shorter with about 20 segments of which only 4, or 3, are broadened and doubly carinate. Here and there the edges of the segments are beset with teeth and spines. The pinnules of the middle of the arm, from about the thirty-fifth brachial onward, are about 7 mm. long with 15–17 segments of which the two basal are short and broad, those following elongate. In contrast to the middle pinnules of var. *insculpta*, from which they differ sharply in the greater number of segments, they are entirely smooth, as the distal ends of the segments are not produced. Toward the arm tips the length of the pinnules seems to increase somewhat. Wherever gonads are developed on the pinnules, as on P_3, the two or three segments covering them are markedly broadened.

The ambulacral plating consists of prominent side and covering plates. Sacculi are of medium size and inconspicuous. The disk is as deeply incised as that of var. *insculpta*.

Locality.—West Indies.

CRINOMETRA BREVIPINNA var. CONCINNA A. H. Clark

[See vol. 1, pt. 1, figs. 206, p. 239, 276, p. 260, 492, p. 367; pt. 2, figs. 76, 77, p. 53, 302, p. 223, 678, p. 338.]

Crinometra concinna A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 646 (description; *Albatross* station 2342).

Antedon brevipinna var. *elegans* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 322 (in key), p. 331 (description; *Blake* station 193), pl. 4, fig. 7, pl. 11, fig. 5.

Crinometra gracilis H. L. Clark, Univ. Iowa Bull. Lab. Nat. Hist., vol. 7, No. 5, 1918, p. 10 (Bahama Expedition station 2).

Description.—The centrodorsal is a flattened hemisphere with the bare polar area 3 mm. in diameter and thickly beset with long tubercles. The cirrus sockets are arranged approximately in 10 crowded columns, two or three to a column, the columns sometimes separated by strongly tubercular ridges.

The cirri are XX, 14–18 (usually 15 or 16), from 25 to 30 mm. long. The first segment is very short, the second and third are about twice as broad as long, the fourth is nearly or quite as long as broad, and the remainder are about one-third again as long as broad, becoming slightly shorter distally; the antepenultimate segment is longer than those preceding, half again as long as broad, and the penultimate segment is about twice as long as broad, its width being somewhat less than that of those preceding. The cirrus segments have their distal ends somewhat enlarged and slightly overlapping, this feature being most marked on the dorsal side of the outer half of the cirri. The opposing spine is minute, terminally situated, and directed obliquely forward. The terminal claw is not so long as the penultimate segment, stout basally but rapidly tapering distally, moderately curved.

The ends of the basal rays are visible in the angles of the calyx; they bear one or more long tubercles.

The radials are concealed. The IBr_1 are very short, often more or less concealed by the centrodorsal, bandlike and curved or narrowly crescentic. The IBr_2 (axillaries) vary from rhombic to approximately triangular, and are two-and-one-half times as broad as long; their lateral borders are as long as those of the IBr_1 and are often, like them, reduced to a point. The IIBr series are usually 2; in eight specimens one IIBr series is 4(3+4), and two are 4, the ossicles united in two synarthrial pairs. The IIIBr series are 2, developed interiorly in 1, 2, 2, 1 order. The edges of the ossicles as far as the third brachial are everted and raised, usually broken up into high blunt tubercles which are more or less confluent with similar high and blunt and also more or less confluent tubercles on the dorsal surface. The IIBr and IIIBr series and first two brachials usually have a high and rather narrow median ridge, which is higher than the tubercles on the dorsal surface; this is sometimes partially or entirely broken up into two or three dorsoventrally elongate tubercles which are larger than any others on the ossicles. The proximal edge of the axillaries and the inner proximal edge of the second brachial are curved upward, while the distal lateral angles of the ossicles preceding the axillaries, and the inner distal angle of the first brachial, are cut away leaving prominent openings serving as water pores. The division series are only slightly convex dorsally, and are in very close lateral apposition.

The 30 arms are 150 mm. long and resemble those of the other forms of the species. The lower brachials to about the fifteenth have strongly everted distal ends which are usually more or less crenulate or tubercular. There is usually a prominent median dorsoventrally elongated tubercle, and usually also some more or less obsolete tubercles on the dorsal surface. From the fifteenth onward the brachials are almost perfectly smooth dorsally. The first sixteen brachials are sharply flattened laterally.

The pinnules are essentially like those of the other forms.

The disk is completely covered with a pavement of very small rounded plates. There are well developed side and covering plates along the pinnule ambulacra.

The color in alcohol is yellowish white, with the calyx, division series, and arm bases as far as the third brachial brownish.

Notes.—A large specimen with the arms about 140 mm. long from *Blake* station 193 differed in so many respects from var. *insculpta* (*decora*), var. *gracilis*, and var. *pulchella* (*pulchra*) that Hartlaub considered it best to regard it as the type of a special variety.

The centrodorsal, of which the dorsal pole is blackish brown, and the division series and arm bases as far as the third or fourth brachial are dark in color. The arms and cirri are in general lighter, though some arms are dark as far as the middle and beyond.

In contrast to var. *insculpta* (*decora*) the centrodorsal is hemispherical and rather high, and it is further distinguished by prominent interradial ridges and processes. The bare dorsal pole shows a deep, circular, almost black central cavity the edge of which is beset with teeth, which also occur on the first segment of the adjacent cirri. There is no further ornamentation on the centrodorsal.

Subradial clefts are present.

The radials are entirely concealed. The whole basal ornamentation, including that of the centrodorsal, entirely lacks the finer protuberances, mostly united into lamellae. The ornamentation of the IBr and IIBr series and in part also of the IIIBr series or the first two brachials shows a characteristic feature in that the borders of the individual ossicles are delimited by a row of small light-colored tubercles, resulting in part in a typical dentation. Besides this, there is on all the ossicles a large median tubercle or median ridge. The lateral borders of the ossicles from the IBr axillaries to the second brachials are somewhat everted and beset with light tubercles, here and there typically dentate; with the exception of the very flat IBr_1 which is entirely covered with tubercles, often gathered into groups of several, there are no tubercles on the smooth dorsal surface of the IBr and IIBr series. From the IBr_1 to the fifth brachial the ossicles have sharply flattened sides. Noteworthy is the everted proximal border of the rhombic IBr axillary. Of the IIBr series, nine are 2 and one is 4(3+4); the IIBr series are 2.

There are 22 arms. The ornamentation of the arms from the fourth to the eighth or tenth brachial, and the form of the brachials, resemble the same features in var. *pulchella*. At about the twelfth brachial the swellings or tubercles stop and liplike ornamentation begins, coincident with the transition of the brachials to a triangular form with diagonal articulations. After the end of the liplike ornamentation, which runs to about the twentieth brachial, the next 10–15, or thereabouts, brachials carry a blunt tubercle on the distal border which was noticed by Hartlaub in other varieties, but in them it is not so prominent, nor does it appear on so many brachials. At about the fiftieth brachial the triangular form passes over into a bluntly wedge-shaped form.

The sequence of the syzygies is rather variable and resembles that in var. *insculpta*. On arms arising from a IIBr axillary the first syzygy is always between brachials 3+4; the second is from between brachials 6+7 to between brachials 16+17, and the distal intersyzygial interval is from 5 to 10 muscular articulations. In the four arms arising from IIIBr axillaries the first syzygy is between brachials 1+2; this is followed by another between brachials 3+4 or 4+5; the next is from between brachials 12+13 to between brachials 16+17; and the distal intersyzygial interval is from 6 to 8 muscular articulations. In the two arms following the IIBr 4(3+4) axillary the first syzygy is between brachials 1+2; on one arm there is another between brachials 5+6; the next syzygy is between brachials 11+12 on one arm and between brachials 12+13 on the other; the following syzygy is between brachials 22+23, and the distal intersyzygial interval is from 4 to 9, usually 6 or 7, muscular articulations.

P_1 is 10–12 mm. long with about 40 segments—the largest number found in any of the varieties of *Crinometra brevipinna*. The 6–8 basal segments are broadened and, with the exception of the first, doubly carinate, a narrow keel being especially prominent on one side of the second-fourth segments. These broadened segments are followed by small elongated segments which toward the pinnule tips become short again and often also broader. The pinnules following to about P_4 are 9–11 mm. long and have a smaller number of segments. On some arms they are as long as P_1, on others 1–2 mm. shorter; the second to fourth segments have a narrow keel on one side. From this point onward the pinnules gradually become shorter. The pinnules of the middle of the arm, from about the twenty-fifth brachial onward, are 7 mm. long with usually 13 segments of which the two or three basal are short. Beyond the fiftieth brachial the length and number of segments again increases. The distal pinnules are 9 mm. long with about 16–18 segments. Most of the pinnules from P_3 onward bear short gonads the two or three segments covering which are broadened.

Especially striking are the dark colored sacculi; the side- and covering-plates are easily visible to the naked eye.

The disk is 11 mm. in diameter and slightly incised, as in var. *insculpta*.

Localities.—*Blake* station 193; *Albatross* station 2342; University of Iowa's Bahama Expedition station 2.

Geographical range.—From northern Cuba to Martinique.

Bathymetrical range.—From 201 to 367 meters.

Thermal range.—One record, 10.56° C.

CRINOMETRA BREVIPINNA var. TRANSVERSA Gislén

Crinometra transversa Gislén, Vid. Medd. Dansk Nat. Foren. København, vol. 93, 1933, p. 478, fig. 5 (?), p. 482, pl. 23, figs. 1–4; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 29.

Description.—The centrodorsal is a thick disk, considerably excavated at the dorsal pole, which is 3 mm. in diameter, granulated and pitted; the interradial portions are covered with stout pointed tubercles. The cirri are arranged in 15–20 crowded columns.

The cirri are XXXVI, 17–18, about 23 mm. long. The first three segments are short, the fourth is as long as broad, the fifth is half again as long as broad, the sixth is one-third again as long as broad, and the eighth is as long as broad. From the eighth segment onward there is a dorsal projection which from the ninth to the twelfth is transformed into a transverse, indistinctly bilobate, crest. The opposing spine is similarly transverse, with sometimes a slight notch in the crest. The terminal claw is slightly shorter than the segment preceding, which is one-third again as long as broad.

The radials are scarcely visible except in the interradial angles where there are some projecting tubercles. The IBr_1 are very short, covered with long tubercles which proximally and distally fuse into serrate flanges along the borders of the ossicle. The IBr_2 (axillaries) have a high mediodorsal tubercle and the flanged proximal and distal borders are provided with three or four stout eminences on each side of the median line both proximally and distally. In this way the margins of the ossicle are bordered by a more or less distinct and everted denticulation; moreover, there is a median dorsal tubercle or crest; otherwise, however, the ossicle is smooth. A crest, well set off, also appears on the first two elements of the IIBr series, which have generally everted margins and sometimes also marginal tubercles. Of the 10 IIBr series, 9 are 2 and one is 4(3+4). The IIIBr series, which are internally developed, are 2.

The 24 arms are 150 mm. long. The first two brachials have a mediodorsal knob and on some arms also slightly everted margins. On the third and fourth brachials there may appear some extra submedian knobs. The median tubercle is later transformed into a dorsal spine or carination which is developed in the distal portion of the ossicle. This tubercle is traceable only a short way along the arm. The distal margin of the brachials soon becomes a little overlapping and more or less denticulate. Though in rather close lateral contact basally, the arm bases are only slightly, or not at all, "wall-sided."

Syzygies occur between brachials 1+2, again from between brachials 16+17 to between brachials 20+21, and distally at intervals of from 2 to 17 (usually about 10) muscular articulations.

P_1 is about 13 mm. long with 27–28 segments. P_2 is 14 mm. long with 24 segments. P_4 is 12 mm. long with 19 segments. P_5 is about 9 mm. long. P_8 is 9 mm. long with 15 segments. P_{13} is 9 mm. long with 15 segments. The distal pinnules are a little longer again; the proximal segments are short, the distal one-third again as long as broad, as in the proximal pinnules. From about P_5 onward the third–fifth segments are somewhat expanded.

The disk, which has been thrown off, is closely granulated with small calcareous granules.

The color is yellowish, except in some of the basal arm parts where it is blackish usually as far as the first brachial.

Notes.—In a second specimen the centrodorsal is flattened dorsally with the free dorsal surface closely pitted. There are rather high interradial crests. There are 20 cirrus sockets, arranged in 10 groups. The cirri have been thrown off.

The IBr axillaries have a well-marked median crest and one or two submedian tubercles, and their borders are a little everted. There is a high keel also on the first two elements of the IIBr series. The ossicles following are provided with high rounded median knobs. Of the 9 IIBr series 7 are 4(3+4) and 2 are 2; there is a single IIIBr 2 series. The carination of the division series and arm bases is much less marked than in the specimen first described, especially on the IBr_1, which is clearly visible; its margins are a little everted, but the tubercles are rather insignificant.

The 21 arms are 60 mm. long. There is a high keel on the first two brachials. The brachials following are provided with high rounded median knobs.

The proximal syzygies are usually between brachials 1+2 after a IIBr 4(3+4) axillary, after a IIBr 2 axillary either between brachials 3+4 or between brachials 1+2 and 3+4.

P_D is about 9 mm. long with about 20 segments. The distal pinnules are 5 mm. long with about 10 segments.

The arm bases are dark colored. Arms regenerating from the first or third brachials are yellowish.

Gislén said that as to the arm sculpture *Crinometra transversa* resembles some of Hartlaub's *brevipinna* varieties, *decora* (=*insculpta*), *gracilis*, and *tuberosa*, and my *insculpta*. But the middle pinnules of the arms are proportionately longer than in most of the other Crinometras; the wall-sidedness of the basal arm parts and the carination of the proximal pinnules are not at all or only slightly developed. The mediodorsal carina of the basal arm parts is more sharply set off than in any of the forms described earlier. But above all, the transverse crest of the cirrus segments distinguishes *transversa* at once from all the Crinometras so far described.

There is no tangible difference between *transversa* and some of the forms of the *Insculpta* type of *Crinometra brevipinna*. In certain of these forms the middle pinnules are as long as they are in *transversa*, the carination of the lower pinnules is only slightly developed, and the distal dorsal end of the cirrus segments, which are as short as in *transversa*, bears a low transverse ridge or a pair of low tubercles (see page 291). This last feature, however, was not known to Professor Gislén, since at the time he wrote no detailed description of the cirri of any of these varieties had been published.

As there is no single character or group of characters by which *transversa* may be distinguished from certain varieties of the *Insculpta* type, I am considering *transversa* as a variety of *brevipinna*, finding its proper place in the *Insculpta* type.

The significance of the occurrence of a form of *Crinometra brevipinna* at St. Helena is emphasized by the unrecorded occurrence of the remarkable *Moiraster magnificus* (Bell), heretofore known only from St. Helena, off Puerto Rico. The U. S. National Museum possesses a remarkably fine specimen with R=168 mm., r=43 mm. from

Caroline station 35, off the west coast of Puerto Rico (lat. 18°24′45″ N., long. 67°14′15″ W.), in 146–329 meters.

Pentacrinoid.—A pentacrinoid larva referred to this species by Professor Gislén is about 3.4 m. long. The calyx is composed chiefly of orals and basals. Small radials appear in the angles between the orals and basals. The orals have everted lateral borders. There are 9 columnals, including the terminal stem plate. The two first columnals are short, the second being wider than the stem. The third and fourth, according to Gislén, are apparently double; they are from half again to twice as long as broad. The fifth and sixth are very long, from three to four times as long as broad. The seventh is much shorter, and the eighth is one-third again as long as broad. The ninth is a short disk attached to a dead *Lophohelia.*

Professor Gislén said that as no comatulid except *Crinometra transversa* is known from this depth in the vicinity of St. Helena this pentacrinoid may be the larva of this form; though the possibility of a species of the family Thalassometridae occurring here cannot be denied.

Localities.—Off St. Helena; 2 miles S. 49° E. from Long Range Point; 280–360 meters; hard bottom; *Dana*, February 24, 1930 [Gislén, 1933].

St. Helena; 2 miles off Bay Point; 480 meters; *Dana*, February 24, 1930 [Gislén, 1933]. The pentacrinoid larva came from this locality.

History.—This variety was described and figured by Prof. Torsten Gislén in 1933 from a specimen that had been dredged by the Danish research steamer *Dana* in 1930 and sent him by Dr. Th. Mortensen. He gave notes on another specimen taken with the type specimen, and described and figured a pentacrinoid which he referred to this species.

CRINOMETRA BREVIPINNA var. TUBEROSA (Hartlaub)

Antedon brevipinna var. *tuberosa* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 322 (in key), p. 333 (description; *Blake* stations 198, 219; no locality), pl. 11, fig. 3.

Description.—Hartlaub referred to this variety three specimens without locality, one from *Blake* station 219, and one from *Blake* station 198. The three specimens without locality are of similar size with the arms about 125 mm. long; the specimen from *Blake* station 219 is similar to these, but stouter; that from *Blake* station 198 has the arms about 115 mm. long. The three without locality agree perfectly in all their characters and are remarkable for the small calyx and long and slender arms—about 120 mm. long from the last axillary.

In all five specimens the contrasting coloration seen in var. *pulchella* and var. *concinna* (*elegans*) is absent. In general they are light in color. The centrodorsal and a few ossicles of the division series are only here and there more darkly colored.

In all five the ornamentation of the division series shows larger and smaller, sometimes sharp, sometimes blunt tubercles which are distributed without special affinity to the borders of the ossicles, in contrast to the conditions seen in var. *concinna*, although here and there, especially on the edges of the axillaries, there may be a typical serration. Noteworthy is the regular presence of a median tubercle of varied form, or a medium ridge, and in addition the production of the dentate, serrate, or crenulate proximal border of the rhombic IBr axillary.

In contrast to var. *pulchella* and var. *concinna*, the tubercles are larger, giving the general ornamentation of the division series a coarser character. Between the cirri and on the interradial processes the centrodorsal has a few small tubercles or teeth which become somewhat larger and more numerous on the bare dorsal pole. The smaller tubercles run outward as far as the second or third brachials. On the first three brachials beyond these there is one, or on syzygial pairs two, median tubercles or humps, this variety in this respect quite resembling var. *pulchella* and var. *concinna*. The five specimens of var. *tuberosa* also agree essentially with these varieties in the ornamentation of the brachials following, from the third to about the sixth, eighth, or tenth.

In the specimen from *Blake* station 198 the tubercle in the middle of the brachials is not so large as it is in var. *pulchella* and in var. *concinna*; this specimen also has more rectangular lower brachials than the others in which diagonal articulations occur after the third brachial. All five specimens first show typical triangular brachials after about the tenth. On many arms at the same time or somewhat earlier or later, the more or less crenulate and everted distal ends appear in typical liplike form. These liplike eversions appear prominently as in var. *pulchella* and in var. *concinna* only on a few of the following brachials—on from four to eight—then gradually become smaller, disappearing slightly beyond the elevated tubercles on the dorsal surface of the brachials. Toward the arm tips the triangular form of the brachials passes over into a bluntly wedge-shaped form.

Hartlaub described all the specimens of this variety in detail. He noted that the three from an unknown locality agree so completely that they may be described together.

The centrodorsal is rather flat, subhemispherical. The very small free dorsal pole is not sharply differentiated. Prominent interradial processes are present, reaching to the height of the IBr_1, but no interradial ridges. The cirri are arranged two or three in a vertical column.

The cirri are XX–XXV, 14–16; the first three segments are short, and the antepenultimate has a conspicuous opposing spine.

The radials are concealed. The IBr_1 are short and are thickly covered with coarse tubercles. The IBr_2 (axillaries), like the IIBr axillaries, are rhombic. All the IIBr series are 2, and a single IIIBr series is 2.

Arms arising from a IBr axillary are rare. The arms in the three specimens number 17, 19, and 21. So far as may be determined by external observation, the first two brachials are always united by muscular articulation. The first syzygy is almost without exception between brachials 3+4, the second from between brachials 9+10 to between brachials 21+22, often between brachials 14+15, 15+16, or 17+18. The third syzygy follows at intervals of from 5 to 18, often 7, 8, 9, and 11 muscular articulations, and the distal intersyzygial interval is 3–12 muscular articulations—in one specimen 4–12, usually 7 or 8; in another 5–9, usually 6–8; and in the third 3–11, usually 6 or 7.

P_1 is about 9 mm. long with 25–30 segments of which usually the first four are strikingly broad and narrowly carinate on both sides; the fifth and sixth segments are moderately broad and are usually somewhat keeled on one side. The shape of these proximal segments, or indeed that of the whole pinnule, does not entirely agree with that of var. *insculpta*; there are, to be sure, marked variation in comparable pinnules of one and the same specimen. The segments following are rectangular or rounded; elongate segments are lacking. Because of the strong expansion of the four proximal segments, the width of the pinnule decreases more or less abruptly, a feature not observed in var. *insculpta*; but Hartlaub remarked it should be noted that in some pinnules such an abrupt decrease in width is not marked. In contrast to the conditions in var. *insculpta*, the following pinnules as far as P_4 are of the same length as P_1, though with fewer (18–20) segments. Regarding the form of these pinnules, it may only be said in general that they are composed of five broad and short segments, followed by elongated ones. The first three or four segments are conspicuously carinate, though in this feature there is great variation. The carination is sometimes more double, sometimes more single; sometimes the crest of the carination is beset with teeth. When gonads are developed—appearing first on P_4—the segments over the gonads, usually the third and fourth, are broadened. From P_5, which is 7 or 8 mm. long, the length of the pinnules decreases. The pinnules of the tenth-fourteenth brachials are about 7 mm. long, that of the sixteenth brachial about 6 mm. The usual length of the pinnules of the middle of the arm, 5–6 mm., may be reached with the pinnule of the eighth brachial. Typical for the middle of the arm are pinnules with two short basal segments followed by usually 10, rarely 11, elongate ones. Most numerous by far are pinnules 6 mm. long with 12 segments, in marked contrast to var. *insculpta* in which the usual pinnules are 3 mm. long with 9 segments. If gonads are developed here—strongly swollen gonads are lacking—the third and fourth segments are broadened. Toward the arm tips, on the seventieth to eightieth brachials, the pinnules become more slender; there is no decrease in the number of their segments, or increase in their length.

The ambulacral plating consists of side and covering plates. The sacculi are rather small and inconspicuous. The disk is deeply incised.

In the specimen from *Blake* station 219 the centrodorsal is hemispherical and rather high. Interradial ridges are here and there evident, as in those just described.

The cirri are XXXII, about 20, longer than those in the specimens described above. The first three or four segments are short, and an opposing spine is present.

There are 10 IIBr 2 series, and therefore 20 arms.

The first syzygy is always between brachials 3+4, the second from between brachials 10+11 to between brachials 17+18, the next after an interval of from 5 to 12, usually 8, muscular articulations, and the distal intersyzygial interval is from 7 to 10, usually 7 or 8, muscular articulations. On one arm the second syzygy is between brachials 8+9 and the third between brachials 34+35. In general the distribution of the syzygies strongly recalls that of the three preceding specimens.

P_1 is 8–9 mm. long with 20–25 segments of which the first seven are broad and those from the second onward are doubly keeled. In some cases this pinnule is only 5 or 6 mm. long, apparently as a result of imperfect regeneration. The shape of the proximal segments varies from that in the corresponding pinnule in the preceding specimens only in that the keels on the proximal segments are broader. The pinnules following up to P_3 on the arms studied are shorter, 6–7 mm. long, that of the sixth brachial even 5 mm. long. In two cases the pinnule of the eighth brachial was found to be exceptionally long, 8 and 9 mm., and in one case barely 4 mm. long showing, however, clear indications of incomplete regeneration. In view of these varying conditions in the pinnule of the eighth brachial, Hartlaub was inclined to assume that, as in the case of the three specimens described, the pinnules as far as the eighth brachial are normally of the same length as P_1 and that the abnormal conditions were the result of imperfect regeneration after loss, or perhaps of arrested growth. Unfortunately a study of all the postradial series was not possible on account of the close apposition of the arm bases. The pinnules of the middle of the arm from about the eighteenth brachial onward are usually 7 mm., rarely 8 mm., long with about 15 segments of which the two first are short and those following elongate. Usually when gonads are developed the 2–4 segments following the second are broadened. In length and in the number of their component segments the pinnules of the middle of the arm exceed those of the three specimens previously described. Whether or not the distal pinnules increase in length cannot be determined because of the poor state of preservation.

The ambulacral plating consists of side and covering plates. The sacculi are somewhat larger than those of the specimens already described. The disk has been lost.

In the specimen from *Blake* station 198 the centrodorsal is rather high and hemispherical, as in the specimen from *Blake* station 219. The cirri are composed of 15–19 segments, as in the specimens first described.

In general the division series are as in the three first specimens, and in the one from *Blake* station 219; but on the 10 IIBr series eight are 2 and two are 4(3+4). There are 20 arms.

The first syzygy is always between branchials 3+4, the second from between brachials 17+18 to between brachials 23+24, usually at about the twenty-first brachial. Only five arms are well enough preserved to permit the determination of the position of the following syzygies. In these the interval between the second and third syzygies is 9, 11, 15, 12, and 7 muscular articulations, and the distal intersyzygial interval is from 5 to 12, usually 10 or 11, muscular articulations. The intervals between the syzygies are therefore somewhat greater than in the three first specimens, and in that from *Blake* station 219.

P_1 is about 8–9 mm. long with 20–25 segments, of which the first 5 are as a rule broad and the second-fifth are singly carinate. The pinnules following as far as P_4, about 8 mm. long, are of approximately the same size as P_1, as in the other specimens of this variety. The pinnules in the middle of the arm from about the eighteenth brachial onward are 6–7 mm. long with 12–15 segments of which the two first are short and those following are elongate. Usually gonads are developed; in this case usually only the third and fourth segments are broadened. Whether or not the distal pinnules increase in length cannot be determined because of the poor state of preservation of the specimen.

The ambulacral plating consists of side and covering plates. The sacculi are rather large. The disk is 8 mm. in diameter, as deeply incised as in the case of the first three specimens, and as in var. *insculpta*.

The most important characters of var. *tuberosa* apart from the ornamentation according to Hartlaub are as follows. The centrodorsal is subhemispherical or hemispherical with the dorsal pole small and not sharply differentiated and prominent interradial processes reaching to the height of the IBr_1, but no interradial ridges. The cirri are rather stout with 20–32 segments and an opposing spine. The radials are concealed. The IIBr series are predominantly 2, rarely 4(3+4). The arms are 17–20 in number. The first syzygy is almost always between brachials 3+4, the second from between brachials 9+10 to between brachials 23+24. P_1 is about 9 mm. long with

20–30 segments of which the basal 4–7 are broad and more or less doubly keeled. The immediately following pinnules are of the same length as P_1, and the pinnules in the middle of the arm, from about the twentieth brachial onward, are 6–8 mm. long with 12–15 segments.

Localities.—*Blake* stations 198 and 219.

Geographical range.—Martinique and St. Lucia.

Bathymetrical range.—From 250 to 276 meters.

Thermal range.—From 11.39° to 13.89° C.

CRINOMETRA BREVIPINNA var. MARGARITACEA A. H. Clark

PLATE 31, FIGURE 94

[See also vol. 1, pt. 2, figs. 683, p. 338, 746, p. 349.]

Crinometra margaritacea A. H. CLARK, Proc. U. S. Nat. Mus., vol. 36, 1909, p 645 (description; *Albatross* station 2154); U. S. Nat. Mus. Bull. 82, vol. 1, pt. 2, 1921, fig. 683, p. 338.

Description.—The centrodorsal is thick discoidal or flattened hemispherical with the bare polar area 3 mm. in diameter, covered with small high tubercles. The cirrus sockets are arranged in 10 closely crowded and somewhat irregular columns, two to a column, the columns sometimes with a row of small tubercles between them.

The cirri are XX, 13–15, 20 mm. long. The first segment is very short, the second and third are twice as broad as long, the fourth is as long as, or somewhat longer than, broad, and those following are about one-third again as long as broad, or rather less, becoming about as long as broad toward the end of the cirrus. The antepenultimate segment is slightly longer than those preceding. The penultimate segment is twice as long as broad, slightly less in diameter than those preceding. The cirrus segments have slightly prominent distal ends, and the last six or seven have a slight low and broad tubercle in the median line of the distal edge on the dorsal side which becomes more prominent distally. The opposing spine is very small, terminal in position, directed obliquely forward. The terminal claw is about three-quarters the length of the penultimate segment, moderately slender and moderately curved.

The ends of the basal rays are visible in the angles of the calyx. They bear one or more long tubercles.

The radials are concealed. The IBr_1 are very short, five or six times as broad as long, with the edges parallel and slightly curved. The IBr_2 (axillaries) are rhombic, about two and one half times as broad as long. The IIBr series are 2. The IIIBr series are 2, developed interiorly, but never present in the full series. The division series and first two brachials are slightly convex dorsally and are laterally in close apposition and sharply flattened. The axillaries are separated on their lateral contiguous edges, forming rhombic water pores. The first and second brachials are similarly separated interiorly. The ornamentation consists of moderately large blunt tubercles distributed evenly over the surface of the division series, becoming less marked after the second brachial and gradually disappearing at about the end of the proximal fourth of the arms. The IIBr and IIIBr series and the first two brachials have a low but prominent rounded narrow median carination. This is continued on to the arm bases in the shape of prominent median tubercles on each brachial, these tubercles disappearing at about the end of the proximal fourth of the arms. The arms are practically smooth in the distal two-thirds.

The arms are 21–29 in number and resemble in structure those of related forms. The first 18 or 20 brachials are laterally flattened.

The pinnules resemble those of related forms but are somewhat more slender, the genital pinnules not being so much expanded.

The disk is completely covered with a pavement of very small plates. Side and covering plates are well developed along the ambulacral grooves.

The color in alcohol is white or dull yellowish.

Localities.—*Albatross* stations 2154, 2155, 2156, 2319–2350.

Geographical range.—Reported only from off northern Cuba.

Bathymetrical range.—From 508 to 567 meters.

CRINOMETRA BREVIPINNA var. DIADEMA (Hartlaub)

Antedon brevipinna var. *diadema* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 337 (description; *Blake* station 101).

Description.—A brilliant white specimen, the lightest colored of all the specimens he studied, from *Blake* station 101 was regarded by Hartlaub as representing a special variety.

The centrodorsal is flat with a flattened dorsal pole which is rather large and is beset with coarse and relatively high toothlike or spiny processes. The corresponding processes in var. *insculpta* are fine and not so high. There are also small tubercles and teeth between the cirri and on the interradial processes. Interradial ridges are present, but are not sharply elevated. The cirri are arranged in vertical pairs.

The cirri are XIX, about 12; the distal segments have no processes on their thickened distal edges, but an opposing spine is present.

The radials, partially concealed, are in part deeply withdrawn within the calyx and are almost wholly covered by the IBr_1, which are flat and bowed. The IBr_2 (axillaries) are rhombic to hexagonal, without a prominent proximal process. The IIBr series are 2. The first four brachials are rectangular; these are followed by a few bluntly wedge-shaped ones, then two or three approximately rectangular, changing rather suddenly to nearly triangular, these persisting to the arm tips. The change in form of the brachials is not so abrupt as in other varieties.

Ornamentation is relatively slightly developed. That of the centrodorsal has been described. On the borders of the IBr_1 there are a few coarse tubercles which make these ossicles appear dentate or crenulate. The proximal border of the IBr_1, like that of the IBr_2 (axillary) is produced in overlapping scalelike fashion. The axillary has merely marginal decorations of the same sort and a median ridge, but is otherwise smooth. On arms arising from a IBr axillary the two first brachials are variable. They are partly beset with several coarse tubercles, but in most cases their surface is flat or only slightly uneven. The proximal border of the first brachial is as a rule dentate. In the middle there is a ridge, or a small round and flattened median tubercle which becomes more pronounced on the third brachial, on the later brachials, in the middle of the raised distal edge, appearing markedly higher and knoblike, in this form and position giving an extremely characteristic fascies to the ornamentation of this variety. Equally characteristic is the fact that from the fifth brachial onward the distal edge is elevated and begins to turn back over the dorsal surface of the brachials in a conspicuous manner. Besides the large knoblike median tubercle there are several smaller ones on the distal border. From about the ninth to the thirteenth brachials the distal edges are turned downward, without becoming typically liplike. At about the eighteenth to twentieth brachial the knoblike median tubercle becomes inconspicuous, and at the same time the distal edge becomes lower and somewhat crenulate, later smooth and slightly thickened.

In arms arising from a IBr axillary the first syzygy is between brachials 3+4, in arms arising from a IIBr axillary, so far as may be judged from the few arms preserved, between brachials 1+2. The second syzygy in arms arising from a IBr axillary is between brachials 16+17 or 17+18, and the third from between brachials 22+23 to between brachials 25+26; the distal intersyzygial interval is 6, 7, or 8 muscular articulations.

P_1 is about 8 mm. long with about 20 segments of which the second-fifth are broadened and carinate. None of the following pinnules are preserved entire. The pinnules of the seventh and ninth brachials are 6–7 mm. long with 14 or 15 segments of which the first 3 or 4 are short, those following elongate. The succeeding pinnules, in the middle of the arm, are shorter, about 5 mm. long, with 10–12 segments of which the first two are short and the remainder elongate; where gonads are developed the third and fourth segments are broadened.

The ambulacral plating consists of prominent side- and covering-plates. The sacculi are colorless. The disk has been lost.

The whole animal, in alcohol, is shining white except for the brownish dorsal pole of the centrodorsal.

Locality.—*Blake* station 101.

Geographical range.—Known only from northern Cuba.

Bathymetrical range.—One record, 320–457 meters.

CRINOMETRA BREVIPINNA var. POURTALÈSI (P. H. Carpenter)

Antedon pourtalèsi P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 54, 208, 209, 211, 212 (in key), 368, 379 (range).

Antedon brevipinna var. *pourtalèsi* HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 339 (description; *Blake* station 219), pl. 14, fig. 1.

Description.—Hartlaub wrote that two specimens from *Blake* station 219 which show little agreement either in the ornamentation of the brachials or in other respects—as for instance the form of the IBr series—were distinguished by Carpenter in the *Challenger* report as representatives of a new species which he called *Antedon pourtalèsi*.

The characters of this new species as given by Carpenter in his key to the species of the *Spinifera* group were: Cirri without definite arrangement on the centrodorsal, composed of 15–25 stout and usually smooth segments; IIBr series and lower brachials with distinctly flattened sides; calyx and arm bases irregularly tubercular; the pinnules from the tenth to the twentieth brachials have the third-fifth segments flattened and expanded laterally. In Carpenter's key *brevipinna* was said to differ from *pourtalèsi* only in having the genital pinnules comparatively slender with very slightly expanded segments.

Hartlaub said that in studying the two type specimens of the so-called species *pourtalèsi* he found in the larger, the only one he regarded as representing his var. *pourtalèsi*, that the genital pinnules began with P_2. At first the gonads are situated rather high on the pinnules, at about the height of the seventh and eighth segments, and then, approximately in the range given by Carpenter, that is from the tenth to the twentieth brachials, they move nearer the base, to the height of the third to fifth or third and fourth segments. The third to fifth, or third and fourth, or fourth and fifth segments are then flat and laterally broadened. This broadening, which Hartlaub frequently pointed out in connection with other varieties, is purely an accompaniment of the swelling of the gonads and is similarly developed in other specimens of *brevipinna*. It is usually lacking in smaller (younger) individuals since in them the gonads contain no ripe sexual cells. Hartlaub expresses his surprise that Carpenter, to whom this relationship between the ripeness of the gonads and the expansion of the pinnule segments covering them must have been known, should have employed such an unstable character for the separation of the two species. He said that he must strongly oppose the supposition that the pinnule segments overlying the gonads in Carpenter's specimens of *pourtalèsi* are significantly and constantly stouter than those in typical specimens of *brevipinna*—for example, in his var. *elegans*. The assumption that relatively slender genital pinnules with only slightly broadened segments are characteristic of *brevipinna* is untenable. So Hartlaub saw no reason for accepting Carpenter's new species.

As already mentioned, the two specimens determined by Carpenter as *pourtalèsi* show rather wide differences. The smaller specimen shows spiny ornamentation, and therefore will be described under the varieties of the *Spinosa* type. The larger specimen, because of its developed ornamentation is naturally associated with the varieties of the *Tuberosa* type. Its characters are as follows.

The centrodorsal is subhemispherical with a scarcely noticeable dorsal flattening. The bare uneven dorsal pole is small with an inconspicuous central cavity. It bears a few rather sharp tubercles, which are also found between the cirri and on the slightly developed interradial processes.

The cirri are XXXVI; none of them are preserved entire. According to Carpenter, who saw the specimen when it was in a better state of preservation, there were 15–20 cirrus segments. The distal segments, according to Carpenter, are smooth, a statement which he applies also to *brevipinna*, but according to Hartlaub's observations does not apply throughout; rather in *brevipinna* the distal edges of the segments in the outer half of the cirri are more or less produced, and the penultimate bears an opposing spine.

The radials are wholly concealed. The IBr_1 are flat and bowed into a kind of scallop with the convexity proximal. The IBr_2 (axillaries) are relatively flat and approximately rhombic. The form of the elements of the IBr series recalls forcibly that in the var. *tuberosa*. All 10 IIBr series are 2, and the 12 IIIBr series also are all 2.

There are 32 laterally compressed arms of which 8 arise from IIBr axillaries and the others from IIIBr axillaries. In the region of the proximal brachials there is to be noticed a double change in form which is best observed on the basis of the direction of the articulations. The articulations of the first three or four brachials are transverse, of the following three or four more or less diagonal, of the next two or three transverse, then strongly diagonal to the arm tips. This feature is much more strongly brought out in the specimen referred to the *Spinosa* type (var. *coronata*).

The ornamentation of the division series, as already noted, agrees naturally with that of var. *tuberosa*, appearing here in reduced form. Also here the basic element of the ornamentation is mostly of usually blunt tubercles, which are exceedingly few. Only the IBr_1 is beset with numerous tubercles, among which a larger rounded median tubercle especially stands out. Except for this, there is only a slight tuberculation on the lateral borders of the ossicles, or in their vicinity, as far as the IIIBr series where it becomes quite inconspicuous. Besides this, the proximal border of the axillaries is tubercular or slightly corrugated. The rest of the dorsal surface of the division series is smooth and only shows a median swelling which does not form a median ridge. On the lowest brachials ornamentation is only indicated. The produced distal ends of the following brachials are thickened and with few exceptions smooth; there is no formation of typical recurved lips such as are present in var. *tuberosa*. Here, and toward the arm tips, a median sharpening of the brachials, a sort of carination, may sometimes be distinguished.

The first syzygy lies at the same height on all the arms. On the arms arising from a IIBr axillary the first syzygy is between brachials 3+4, on arms arising from a IIIBr axillary between brachials 11+2. The second syzygy in arms arising from a IIBr axillary is from between brachials 16+17 to between brachials 27+28, and on arms arising from a IIIBr axillary from between brachials 15+16 to between brachials 35+36; but in the latter case there may be syzygies between brachials 4+5, 5+6, and 9+10. In arms arising from both IIBr and IIIBr axillaries the distal intersyzygial interval is from 9 to 20, usually 12–16, muscular articulations.

P_1 is about 10 mm. long with 25–30 short and approximately quadrangular segments of which the first five are broad and feebly carinate. The pinnules following are shorter. The pinnules in the middle of the arm are 5–6 mm. long with 12–13 segments of which the first two are both short, those following elongate. Gonads are usually present, roofed over by the modification of the segments already described. Individual gonads occur nearly to the arm tips. Here the pinnules are very slender, apparently somewhat longer, and are composed of about 15 segments.

The arms are estimated as about 120 mm. in length.

The ambulacral plating is composed of rather large side and covering plates. The sacculi are rather small. The disk is typically rather deeply incised, 15 mm. in diameter. In alcohol the disk is light gray, the skeleton gray with a yellowish tinge, the centrodorsal and base of the postradial series somewhat darker.

Locality.—*Blake* station 219.

Geographical range.—Off St. Lucia; according to Carpenter "Caribbean Islands."

Bathymetrical range.—The only definite record is 276 meters; Carpenter gives the range as 227–479 meters.

Thermal range.—One record, 13.89° C.

CRINOMETRA BREVIPINNA var. LAEVIS (Hartlaub)

Antedon brevipinna var. *laevis* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 342 (description; *Blake* station 269), pl. 11, fig. 6.

Description.—A medium-sized specimen, unfortunately mutilated, from *Blake* station 269 was considered by Hartlaub as a representative of a special variety showing some characteristic features.

The centrodorsal is subhemispherical, low, with a rounded bare dorsal pole studded with coarse tubercles, which are also found between the cirri and especially on the well developed interradial processes.

The cirri are XV, with three short and strikingly thick basal segments. No cirri are completely preserved.

The radials are concealed. The IBr$_1$ and the hexagonal IBr$_2$ (axillaries) are rather flat; the axillaries lack a posterior process. The IIBr series are 2.

The ornamentation as far as the third brachial is very characteristic. The IBr$_1$ bear rather large tubercles which are mostly marginal, and in addition a conspicuous median tubercle. The IBr$_2$ (axillaries) have a thickened and somewhat produced dentate proximal border, but the distal border is lower and usually smooth; on the otherwise smooth surface there is a strongly produced median ridge. On the IIBr series and first three brachials this median ridge or median swelling is the most conspicuous and, apart from slight irregularities of the surface, the only ornamentation. The angular sharpening of the ossicles produced in this way, which is evident in part also on the brachials, furnishes an easy recognition mark for this variety, as does the lack of all ornamentation from the third brachial outward, where there is nowhere any trace of the thickening of the distal edges that is in other varieties almost always present.

There are 15 arms. The articulations of the first three brachials are transverse, those following diagonal, the brachials changing their form accordingly. The arms appear stiff. Unfortunately the arms are poorly preserved so that it cannot be determined whether they decrease in width rather rapidly or gradually from the broad base. The middle portion of the arms is already strongly compressed laterally. This decrease in width of the arms is exceedingly characteristic of this variety.

In arms arising from a IBr axillary the first syzygy is as a rule between brachials 3+4, in arms arising from a IIBr axillary between brachials 1+2. In the single better preserved arm arising from a IBr axillary the following syzygies are between brachials 19+20, 26+27, and 30+31.

None of the lower pinnules are preserved entire. They appear to be short with strong carinate basal segments. A pinnule from the middle of the arm is 3 mm. long with 8 segments which, with the exception of the first two, are elongate.

The arms have an estimated length of 40–50 mm.

The ambulacral plating consists of stout side and covering plates. Sacculi are not apparent. The disk is high, deeply incised, 5 mm. in diameter.

In alcohol the skeleton is whitish gray, the disk darker gray.

Locality.—*Blake* station 269.

Geographical range.—Known only from off St. Vincent.

Bathymetrical range.—Known only from 227 meters.

Thermal range.—One record, 14.17° C.

CRINOMETRA BREVIPINNA var. BREVIPINNA (Pourtalès)

Comatula brevipinna Pourtalès, Bull. Mus. Comp. Zool., vol. 1, No. 6, 1868, p. 111 (description; off Havana, 270 fathoms; *Corwin* [station 2]).

Antedon brevipinna P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, part 60, 1888, pp. 54, 207, 208, 211, 212 (in key), 378 (Straits of Florida; 270 fathoms [*Corwin* station 2]).—Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 313 (reprint of original description and redescription of the type specimen from *Corwin* station 2; descriptions of specimens from *Blake* stations 232, 269), pl. 1, figs. 17, 18, 21, pl. 3, figs. 1, 3, pl. 4, fig. 2.

Crinometra brevipinna A. H. Clark, Journ. Linn. Soc. (Zool.), vol. 36, No. 249, April 1929, p. 658 (off St. Thomas; 240 fathoms).

Description.—Hartlaub's redescription of the type specimen from *Corwin* station 2 is as follows: The centrodorsal is dome-shaped with a bare dorsal pole; there are strong interradial processes, but no interradial ridges.

The cirri are XVI, all broken off beyond a few basal segments. According to Pourtalès they have about 15 long segments. Hartlaub said that the first two segments are very short, those following markedly longer than broad.

The radials are entirely visible; in the proximal portion of the median line they bear a conspicuous tubercle. They are laterally in close contact, and their lateral edges show several small tubercles or dentations which in many places interdigitate with those on the neighboring radials. Their distal border is gently concave. The IBr_1 and IBr_2 (axillaries) have a sharp median keel; together they form a synarthrial tubercle which does not appear as a unit, since the two ridges are separated by the articulation. The IBr_1 are broadly in contact laterally; their lateral borders, like those of the radials, are tubercular or dentate, and their proximal border is slightly convex and bears very small tubercles. The IBr_2 (axillaries) are pentagonal; their proximal and distal edges are bowed outward and are in places slightly tubercular. They are free laterally. The lateral borders are dentate, but lateral contact surfaces are present. There are two IIBr 2 series. In one of these, which is fully developed, the lateral borders of the ossicles are free, but the inner sides of the first two brachials are in close contact; both these brachials have a slight median elevation of the dorsal surface. The other IIBr series is regenerating. It is followed by a IIIBr 2 series.

There are 13 arms with an estimated length of 35 mm. The first two brachials are short, broader than long, approximately rectangular; their lateral borders are dentate. From the fourth brachial onward the brachials become longer and more squarish; their proximal and distal ends show a sharp process which is visible on the dorsal surface of the arms. In the middle of the arms the brachials become approximately wedge-shaped and longer, and the processes arise on the sides of the arms. All the brachials are smooth. The ends of the arms are broken off.

In arms arising from a IBr axillary and in those arising from a IIBr axillary the first syzygy is between brachials 3+4; in arms arising from a IIIBr axillary it is between brachials 1+2. The second syzygy is from between brachials 15+16 to between brachials 17+18, and the third is between brachials 21+22 or 22+23.

P_1 is about 3 mm. long, longer than any of those following, with about 13 segments of which the basal three or four are broader than long and the second–fourth are moderately carinate; from the fifth onward the segments become gradually narrower and longer. P_2 and P_3 are shorter, about 2 mm. long; the two or three lowest segments are broad. In the pinnules following these become more slender and toward the middle of the arm the basal segments no longer differ from those following. These pinnules, about 2 mm. long, have 6 or 7 stout segments of which the first two are short and the terminal are markedly longer than those of the earlier pinnules. Pourtalès said that the pinnules in the middle of the arms have 5 segments.

The ambulacral surface of the arms and pinnules show sacculi and prominent plating. The disk is 3 mm. in diameter.

A small specimen from *Blake* station 232 is not half so large as Pourtalès' type specimen, the arms being only about 15 mm. long. Some of the cirri are complete. They have 12–14 segments of which the first two are short and the third, fourth, and fifth are markedly elongate, the third the longest; the segments following become gradually shorter, and their distal ends become broader and show produced points so that the dorsal profile of the cirri here appears serrate. The opposing spine is directed outward.

The radials are largely visible. The IBr_2 (axillaries) show traces of dentation on the proximal and lateral borders, all the other ossicles of the division series being smooth. The arms are all broken off near the base; their number is presumably 10. Hartlaub remarked it is noteworthy that while the radials are in close lateral contact the ossicles of the IBr series are laterally entirely free and do not have sharply flattened sides.

A second specimen from *Blake* station 232 is somewhat larger than the type specimen, with the arms about 40 mm. long. Most noticeable in this specimen is the shape and tilelike imbrication of the elements of the IBr series. As in the type specimen, the radials bear a moderately pointed median tubercle. These tubercles stand in approximately the same height as the strong interradial processes of the centrodorsal so that the base of the postradial series shows a crown of 10 tubercles. The IBr_1, tapering in its distal half, is approximately trapezoidal and, together with the axillary, bears a conspicuous median angular tubercle and a produced and overlapping proximal border. The IBr_2 (axillary) is almost triangular. One IIBr 2 series is present.

There were apparently 11 arms. On arms arising from a IBr axillary the first syzygy is between brachials 3+4 and the second from between brachials 14+15 to between brachials 17+18. Like the elements of the IBr series, the elements of the IIBr series bear an elongate median crest.

Hartlaub noted that here for the first time there is an indication of the brachial ornamentation so highly developed in the large specimen. The articulations of the brachials are broad and everted so that the individual brachials stand out strongly and the dorsal profile of the arms is almost serrate or dentate. P_1 is composed of 12 or 13 segments of which the two first appear approximately triangular, those following more rectangular; the second and third are somewhat carinate outwardly; all the segments are of about the same length. P_a has four short and approximately squarish segments, those following being longer. P_2 has 10 segments of which the first three are short and the remainder elongated. P_d, which is short with 8 or 9 segments of which the first two are short and the others elongated, represents essentially the typical form of pinnule in the middle of the arm. The length of the pinnules apparently decreases gradually from P_1 to about P_9.

A third specimen from *Blake* station 232 is larger with the arms about 50 mm. long. The cirri have 10–14 segments of which the first two are short and those following elongate, and the penultimate bears an opposing spine. The form and the tilelike imbrication of the elements of the IBr series are much less characteristic than in the other specimens. In the position of the first and second syzygies and in the presence of one IIBr 2 series there is, however, great similarity; but the IBr axillary is not triangular but almost rhombic, and there is a slight tuberculation or dentation on the overlapping proximal edge of the elements of the IBr series.

P_1 is about 6 mm. long with 20–22 segments of which the first five are broad and somewhat carinate and those following are elongate, the terminal becoming shorter again and very small. The pinnules following become gradually shorter. P_d or P_e is

2–3 mm. long with 8 or 9 segments, of which the two basal are broad and short and the others elongate. As in the preceding specimen, it represents the form typical for the middle of the arm.

The fourth specimen from *Blake* station 232 is larger than the type specimen, having the arms with an estimated length of 45 mm. Hartlaub says it is rather different from the preceding specimens, and it is doubtful whether it belongs to the same species. Regenerating arms occur on each of the five postradial series. The absence of all ornamentation on the division series is striking. The radials and the elements of the IBr series are smooth; at the most a suggestion of a production of the proximal border of the IBr_2 (axillary) may be noted. The radials are visible, somewhat overlapped by the produced proximal edge of the IBr_1. The IBr_2 (axillaries) have a proximally directed posterior process. Subradial clefts occur between the conspicuous interradial processes of the centrodorsal. The IBr_1 and following ossicles have sharply flattened sides.

The number of arms originally possessed by this specimen cannot now be determined. There are only two of the original arms arising from a IIBr axillary. In one of these the first syzygy is between brachials 3+4, the second is between brachials 19+20, and the third is between brachials 27+28; in the other the syzygies are between brachials 5+6, 18+19, and 26+27. In addition to this IIBr 2 series, there is another similar one, and also one IIBr 4(3+4) series. There are two IIBr 1 series, and one IIBr 2(1+2) series.

P_1 is 6 mm. long with 12 segments, all of the same length except the first which is shorter. The pinnules in the middle of the two arms originally present are composed of 7 or 8 stout segments; characteristic of these pinnules is the fact that from the third to the penultimate segment they are of approximately the same width, only the terminal segment tapering. The two basal segments are short and moderately broad, all the others elongate.

A medium sized specimen from *Blake* station 269, according to Hartlaub, is better preserved and therefore permits a better comparison with the type specimen. It is larger than those previously noticed, with an arm length of about 55 mm. It is noteworthy that on the centrodorsal, which is more flattened than that of the type specimen, the bare dorsal pole is studded with a strongly developed tubercular efflorescence. Smaller tubercles are found on the sides between the cirrus sockets and also on the not especially well developed interradial processes. An opposing spine is developed, as in the first specimen from Blake station 232. In contrast to the type specimen, the radials are scarcely visible. The IBr_1 are rather flat, with a well developed median tubercle; small blunt tubercles also occur on the dorsal surface and on the distal edge; the lateral borders are dentate and irregular, as in the type specimen. The ornamentation of its proximal border is more developed than in the type specimen—everted and winglike, and also pleated. The IBr_2 (axillaries), which are more rhombic than pentagonal, have a broad median crest; their lateral borders show here and there a typical dentation; the proximal and distal edges are essentially like those of the IBr_1. As a rule the IIBr series are 2, but one IIBr 4 series is present which all indications suggest owes its origin to regeneration. The elements of the IIBr series have everted proximal borders and often typically dentate lateral edges, as well as a conspicuous median elevation; the axillary is approximately rhombic. The IIBr series and first two brachials have sharply flattened lateral borders.

There were at least 15 arms. The first syzygy is usually between brachials 3+4 as in the type specimen, and the second is far distant, from between brachials 13+14 to between brachials 24+25.

As in the type specimen, P_1 is the longest with about 18 segments of which the basal three or four are broad and keeled, those following always short, becoming gradually narrower. The three basal segments of the following pinnules up to P_3 are also broad and carinate. The short and stout pinnules from the middle of the arm have mostly 8 segments of which the two basal are broad and those following elongate. Toward the end of the arms the pinnules appear to become somewhat longer again. The individual brachials are emphasized by broad and deep-lying articulations, which give the arms a characteristic appearance.

Another somewhat larger individual from *Blake* station 269, which has only a single arm preserved beyond the base, has an estimated arm length of 65 mm. In essentials it agrees with the preceding. The ornamentation of the centrodorsal and of the division series is in close agreement. The radials are not visible. The IIBr series are 2, and a single IIIBr 2 series is present. The first syzygy is between brachials 3+4, and the proximal three or four segments of P_1, which in no case is preserved entire, are in this specimen also broad and carinate.

Localities.—*Corwin* station 2; *Blake* stations 232, 269; off St. Thomas.

Geographical range.—From northern Cuba to St. Vincent.

Bathymetrical range.—From 159 to 494 meters.

Thermal range.—From 14.17° to 16.67° C.

Remarks.—The var. *brevipinna* has no real validity in fact. Pourtalès' type specimen and the specimens described by Hartlaub are young individuals in which the varietal characters have not as yet become distinctive. Pourtalès' type specimen is probably simply a young individual of var. *granulifera*, and the specimens from *Blake* stations 269 and 232 appear to be young individuals of var. *insculpta*.

CRINOMETRA BREVIPINNA var. SPINOSA (Hartlaub)

Antedon brevipinna var. *spinosa* HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 343 (description; no locality), pl. 11, fig. 8.

Description.—Hartlaub said that a rather small specimen from an unknown locality with the arms about 70 mm. long forms in regard to its ornamentation—uniformly distributed spines—an exceedingly interesting parallel to the second Martinique specimen of what he considered to be *granulifera* (see page 326). To Hartlaub it seemed that this specimen represented a transition to *granulifera*, although it shows various differences.

In particular the centrodorsal is markedly flatter than the more hemispherical centrodorsal of the specimen of *granulifera*. Like most specimens of *brevipinna* it possesses a typical flattened bare dorsal pole, which is uneven. No interradial ridges are present, but there are prominent interradial processes.

The cirri are XXII, 14–16; an opposing spine is present.

The radials are flat, obscured, though entirely visible. In the specimen of *granulifera* mentioned the radials are clearly visible. In both specimens there are narrow subradial clefts. The IBr_1 are also flat; the IBr_2 (axillaries) are pentagonal, not especially high, with a straight proximal border. All the IIBr series except for a single deformed one are 2, in contrast to the condition in *granulifera*. There are no IIIBr series.

There is striking agreement between the present specimen and the specimen of *granulifera* in respect to the ornamentation of the division series and lower brachials. The surface of the ossicles is beset with thick, erect, coarse, sometimes sharp and sometimes more blunt spines or teeth which are partially coalesced, their distribution being approximately uniform without a tendency to greater development along the borders of the ossicles. The distal limit of this ornamentation lies at about the tenth or twelfth brachial. The surface of the following brachials is in both cases flat, and their edges are thickened and slightly crenulate.

There are 16 arms. The change in shape of the lower brachials is noteworthy. Up to the third brachial on arms arising from a IIBr axillary, or fourth brachial on arms arising from a IBr axillary, the articulations are transverse and the brachials therefore discoidal or quadrangular; then follow about four bluntly wedge-shaped brachials with diagonal articulations; then one or two rectangular brachials with transverse articulations, which usually delimit the basal ornamentation. The brachials following are longer and approximately triangular. Toward the arm tips the brachials again become shorter and more bluntly wedge-shaped, and finally almost cornet-shaped with widely flaring ends. Hartlaub remarked it is worthy of note that a similar condition may be seen on some of the arms of the *granulifera* specimen, especially in the lower brachials.

The sequence of the syzygies on two similarly preserved arms arising from a IBr axillary are: Between brachials 3+4, 5+6, and 14+15; and on the other arm between brachials 3+4 and 16+17. On arms arising from a IIBr axillary the first syzygy is almost always between brachials 1+2, as in the *granulifera* specimen. In a few cases this is followed by a syzygy between brachials 3+4; whether this last is present or not the next syzygy is from between brachials 14+15 to between brachials 20+21, and that following is from between brachials 22+23 to between brachials 28+29. A syzygy between brachials 10+11, often present in *granulifera*, Hartlaub could not find in this specimen.

On arms arising from a IBr axillary P_1 is unfortunately preserved only as far as the fourteenth segment; the first five segments, as in P_D in the specimen of *granulifera*, are broad with a spiny border. On arms arising from a IIBr axillary P_1 is shorter with fewer segments, about 5 mm. long with about 15 segments of which the first four are also broadened and spiny edged. The following pinnules gradually decrease in length and in the number of their component segments. From about P_4 onward the pinnules are short, only 4 mm. long, with about 7 segments of which the first two are short and those following are elongated. In a few pinnules in which gonads are in process of formation, the third and fourth segments are broadened. Toward the arm tips the pinnules become longer again; here they are slender, about 5 mm. long, with 10 segments.

The ambulacral plating consists of prominent side and covering plates. The sacculi are rather small. The disk is 6 mm. in diameter, brown, and rather deeply incised.

The skeleton, in alcohol, is dingy yellow brown.

Locality.—West Indies.

CRINOMETRA BREVIPINNA var. GEMMATA A. H. Clark

Plate 30, Figure 92

[See also vol. 1, pt. 2, fig. 679, p. 338.]

Crinometra gemmata A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 647 (description; *Albatross* station 2330); U. S. Nat. Mus. Bull. 82, vol. 1, pt. 2, 1921, fig. 679, p. 338.

Antedon granulifera (part) Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 298 (second specimen from Martinique), pl. 5, figs. 7, 9, pl. 12, fig. 8.

Crinometra ornata H. L. Clark, Bull. Lab. Nat. Hist. Univ. Iowa, vol. 7, No. 5, 1918, p. 11 (Bahama Expedition stations 9, 16; notes).

Description.—The centrodorsal is hemispherical with the bare polar area small and papillose. The cirri are arranged in two irregular crowded rows, showing a tendency toward a columnar arrangement, two columns to each radial area.

The cirri are XX, 12–15, from 20 to 25 mm. long. The first segment is very short, the second is twice as broad as long, the third is nearly as long as broad, the fourth is half again as long as broad, the fifth–seventh are about twice as long as broad, and those following slowly decrease in length to about half again as long as broad on the antepenultimate. The penultimate segment is twice as long as broad, slightly less in lateral width than those preceding. The distal edge of all the segments is slightly produced, overlapping the bases of the segments succeeding, and the terminal six to eight have slight terminal spines on the dorsal side, most developed on the antepenultimate. The opposing spine is small, terminal, and directed obliquely forward.

The ends of the basal rays are visible as elongate tubercles in the angles of the calyx; they are usually covered with short fine spines.

The radials are concealed, or just visible over the ends of the basal rays. The IBr_1 are very short and bandlike, of uniform height, strongly curved, with the proximal edge everted and dentate; they bear a row of small pointed tubercles which are sometimes more or less confluent midway between the anterior and posterior borders. The IBr_2 (axillaries) are rhombic, two-and-one-half times as broad as long, with the anterior and posterior angles approximately equal and the lateral edges about equal to those of the IBr_1. The IIBr series are 4(3+4), in one specimen twice 2. The IIIBr series are 2(1+2), but only a single one is present, developed interiorly. The division series are in close lateral apposition and are sharply flattened laterally. They are strongly and evenly convex dorsally, so that the dorsal portion of P_D is exposed. The division series and arms as far as the fourteenth brachial are thickly beset with numerous small sharp conical tubercles which exhibit a tendency to arrange themselves in horizontal rows; these become more numerous and more slender along the edges of the ossicles of the division series. Seen without a glass, the proximal portion of the animal has the appearance of being finely and evenly granulated.

The 19–21 arms are from 110 to 125 mm. long, except for the basal ornamentation resembling those of other forms of the species.

The pinnules in general resemble those of the other forms. On the ornamented proximal portion of the arms they are strongly carinate, the carination being more or less coarsely tubercular or irregular. The third and fourth segments of the genital pinnules are considerably expanded. The distal pinnules are 8 mm. long.

The disk is completely covered with a pavement of very small plates. Side and covering plates are well developed along the pinnule ambulacra.

The color in alcohol is white.

Notes.—Dr. Hartlaub sent me for criticism the proof of his plate 5 and, as he mentions on page 300, I identified his second specimen of *Antedon granulifera* from Martinique (fig. 9) as this form.

This specimen is considerably smaller than the first (see under var. *granulifera*, p. 330). While in the latter the IBr_1 is 4 mm. broad, in this it measures scarcely 3 mm. But in spite of this the arms are of considerable length, one of them, measured with a thread, reaching 140 mm.; it is broken at the tip and must have been 20 mm. longer. The expanse of this specimen was estimated at about 310 mm.

There are 16 arms. All the IIBr series are 4(3+4). There are no IIIBr series and one of the postradial series lack IIBr series. Hartlaub says that the ornamentation is not dissimilar to that of the small specimen of var. granulifera from *Blake* station 34, though here the lower brachials are thickly beset with erect coarse spines which are quite irregularly placed and partially, through fusion of several into one, become more dentate. The largest spines are on the dorsal surface of the segments, the edges of the brachials carrying smaller ones. On the division series the spines are markedly smaller. On the IBr series a weak median ridge may be distinguished.

In the four arms arising from a IBr axillary the sequence of the syzygies is as follows: (1) between brachials 3+4, 14+15, 19+20, 25+26, 32+33, and 37+38; (2) between brachials 3+4, 10+11, 15+16, 22+23, and 28+29; (3) between brachials 3+4, 5+6 (?), 12+13, 22+23, 29+30, and 37+38; (4) between brachials 3+4, 16+17, 19+20, 24+25, 32+33, and 38+39.

In five arms arising from IIBr axillaries the syzygies are as follows: (1) between brachials 1+2, 3+4, 10+11, 18+19, 26+27, and 32+33; (2) between brachials 1+2, 13+14, and 20+21; (3) between brachials 1+2, 12+13, and 19+20; (4) between brachials 1+2, 10+11, 19+20, 27+28, and 32+33; (5) between brachials 1+2, 6+7, and 16+17. In a study of other arms Hartlaub found commonly a syzygy between brachials 10+11, which was sometimes the second, sometimes the third syzygy.

P_D is about 10 mm. long and is composed of about 30 short and broad segments. Their dorsal edge, of which a broad strip is visible between the appressed arms, is sculptured in the same way as the arm bases. P_1 on arms arising from a IBr axillary is similar. The proximal pinnules are markedly shorter than those of the third specimen (var. *granulifera*) from Martinique (see page 330).

Dr. Hubert Lyman Clark referred one good specimen from the University of Iowa's Bahama Expedition station 16 and arm fragments from station 9 to *Crinometra ornata*. He said that the specimen and fragments of this *Crinometra* do not correspond in detail with Hartlaub's description and figures, but it is better to refer them to the same name than to introduce a new name into this already badly confused group.

He said that the individual before him has the centrodorsal so thickly covered with cirri that it is difficult to determine its size and shape. At the dorsal pole are a few high, compressed, irregular granules and ridges.

The cirri are about XX, 17–20. The penultimate bears a conspicuous opposing spine while the 3–6 preceding have a similar but increasingly ill-defined dorsal projection near the distal margin. The distal margins, particularly of the basal segments, are flaring so that they form a conspicuous socket for the next succeeding segment.

All the segments are longer than broad, except the basal three, and the fifth (or sixth) is the longest.

There are 23 arms of which two are very small. The longest exceed 100 mm. Dr. Clark said that in their ornamentation the arms are more like Hartlaub's fig. 9, pl. 5 (second specimen from Martinique) than they are like the figures he gives for var. *ornata* (to which he referred the specimen), but he was not at all clear as to how much weight slight differences of ornamentation properly carry in *Crinometra*.

The difference between Hartlaub's *Antedon brevipinna* var. *ornata* and the second specimen from Martinique (pl. 5, fig. 9) which he identified as *Antedon granulifera* is not in the ornamentation, but in the character of the IIBr series—2 in *ornata*, 4(3+4) in *granulifera*. Dr. Clark does not mention the division series in his discussion.

Dr. Clark said that the pinnules of the specimen in hand are remarkable for the very great width of some of the basal segments. Thus P_5 is 6 mm. long with 10 segments of which the third is 0.75–0.80 mm. high and a trifle more than 1 mm. broad, while the fourth is about as broad and is fully 1 mm. high; succeeding segments are much narrower.

He remarked that it will be at once noted that these pinnules are utterly different from Hartlaub's fig. 6, pl. 4, but they are apparently identical with those shown in the photograph, fig. 4, pl. 12. He said "No doubt Hartlaub has at least two distinct species confused under his 'variety *ornata*!' " Dr. Clark overlooked the fact that the genital pinnules vary widely in shape according to the state of development of the gonads.

He said that the arm fragments at hand (from station 9) agree perfectly in ornamentation and in pinnules with the whole specimen, and there is no doubt of their identity.

Localities.—*Albatross* stations 2330, 2333; University of Iowa's Bahama Expedition stations 9, 16; Martinique.

Geographical range.—From northern Cuba to Martinique.

Bathymetrical range.—From 221 to 366 meters.

CRINOMETRA BREVIPINNA var. CORONATA (Hartlaub)

Antedon pourtalèsi (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, pp. 54, 208, 209, 211, 212 (in key), 368, 379 (range).

Antedon brevipinna var. *coronata* Hartlaub Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 345 (description; *Blake* stations 219, 241, 272), pl. 11, fig. 7.

Description.—Hartlaub said that a medium-sized specimen from *Blake* station 241 and another somewhat smaller but of similar habitus and of a similar reddish color from *Blake* station 272 recall in the ornamentation of the lower brachials the first Martinique specimen of *granulifera* (see page 330). But the agreement is not so close as in the case of the specimen described as var. *spinosa*. In addition to these specimens Hartlaub described as a representative of var. *coronata* a specimen deviating somewhat from those from *Blake* station 219 that Carpenter had designated as *pourtalèsi*.

In the specimen from *Blake* station 241 the centrodorsal is highly arched and slightly flattened dorsally. Only a small, somewhat excavated, bare dorsal pole is present. The interradial processes are well developed. In the specimen from *Blake* station 272 the centrodorsal is flatter with a more pointed dorsal pole so that its form approaches the conical, and the interradial processes are not so well developed.

In the specimen from *Blake* station 241 the number of the pure white cirri is about XXX, in that from *Blake* station 272 about XX. The segments, except for the first three or four, are elongated. The cirri are entire only in the specimen from *Blake* station 272, in which they have 18–20 segments of which the 8 outermost have processes on the distal ends and the penultimate bears an opposing spine.

In the smaller specimen from *Blake* station 272 the radials, although withdrawn, are visible, but they are almost entirely concealed in the specimen from *Blake* station 241. The IBr_1 and IBr_2 (axillaries) are relatively flat in both; there is a marked synarthrial tubercle. The axillaries are sometimes pentagonal, sometimes more rhombic, but in any case without a marked posterior process. The $IIBr_1$ in the IIBr 2 series is rather high and rectangular. In the specimen from *Blake* station 241 there are 8 IIBr series of which six are 2 and only two are 4(3+4). In the smaller specimen from *Blake* station 272 all five IIBr series preserved are 4(3+4). In addition to the IIBr series, the specimen from *Blake* station 219 has one IIIBr 2(1+2) series. Here again the variation in shape of the lower brachials can be seen, the first three being rectangular with transverse articulations, followed by four or five bluntly wedge-shaped with diagonal articulations, then two or three transverse articulations with one or two rectangular brachials, followed by approximately triangular brachials with strongly diagonal articulations. A similar condition is seen in the lower brachials of the specimen of *granulifera* from Martinique.

According to Hartlaub these two specimens differ from the *granulifera* specimen mentioned, and also from *Charitometra basicurva*, which has a similar brachial ornamentation, in that the elements of the division series are not smooth but ornamented. In the specimen from *Blake* station 241 there are small more or less sharp spines or dentations which are arranged along the edges, usually in a single row. In the specimen from *Blake* station 272, which is smaller, this ornamentation is not so well developed, the dentations are smaller, and blunter, though the marginal dentation of the ossicles is everywhere easily recognizable. On the IBr_1 of this specimen the median elevation is approximately in the form of a knob. It is not present in the specimen from *Blake* station 241. The ornamentation of the first 10 to 12 brachials consists of a crown of more or less high, erect, sharp teeth or spines on the distal edge which are typically developed especially in the smaller specimen from *Blake* station 272. In contrast to the first Martinique specimen of *granulifera* the proximal border of the brachials may also be ornamented with small spines or teeth; this feature is very characteristically developed on the lower brachials of some arms of the specimen from *Blake* station 241. After the tenth or twelfth the brachials are smooth and have thickened and slightly crenulate distal borders.

Since in both specimens only a small fraction of the arms originally present are preserved—in the smaller they are mostly broken off and in the larger they are regenerating—only limited statements can be made regarding the original arm numbers, the distribution of the syzygies, and the outer pinnules. With the regenerates the number of arms in the specimen from *Blake* station 241 is 19, and the number in that from *Blake* station 272 is 15.

The sequence of the syzygies in the two fairly well preserved arms of the specimen from *Blake* station 272, one being an original arm from a IBr axillary and the other a regenerated arm from a IIBr axillary, is as follows. In the arm from a IBr axillary syzygies occur between brachials 3+4, 14+15, 22+23, 25+26, and 32+33. In the arm arising from a IIBr axillary syzygies occur between brachials 1+2, 3+4, 18+19, 28+29, and 36+37. In the specimen from *Blake* station 241 there are three arms arising from IIBr axillaries in which the first syzygy is between brachials 1+2 and the second is between brachials 3+4. On an arm arising from a IBr axillary which bears regenerated brachials from the epizygal of the second syzygial pair onward the syzygies are between brachials 3+4, 4+5, 26+27, 35+36, 45+46, and 58+59.

In the specimen from *Blake* station 241 P_1 on arms arising from a IIBr axillary is about 10 mm. long with about 20 segments of which the first six are broadened and the third–sixth bear a typical hatchet-formed, or convex, keel. In the specimen from *Blake* station 272 this hatchetlike carination is not evident. Here the corresponding keels are straight and narrower. The pinnule inself is 7–8 mm. long with about 20 segments. The pinnules following become gradually shorter and the number of their segments fewer. The pinnules of the middle of the arm may be observed only on unregenerated arms in the specimen from *Blake* station 272. They are 4 mm. long with 8–10 segments of which the two basal are short, the remainder elongated. Where gonads are developed the third and fourth segments are broadened. In this variety these pinnules resemble those of the first Martinique specimen of *granulifera*. Toward the arm tips the pinnules of this specimen are twice as long and are composed of 14 segments which, with the exception of the first two, are very slender.

The ambulacral plating consists of prominent side and covering plates. The sacculi are very small, on many pinnules not visible. In the specimen from *Blake* station 241 the arms are about 90 mm. long, in that from *Blake* station 272 about 60 mm. long.

In alcohol the color of the specimen from *Blake* station 241 is gray, that of the specimen from *Blake* station 272 white. In both the cirri are shining white. In the specimen from *Blake* station 241 the division series are gray, in that from *Blake* station 272 almost white. The arms of both are light reddish gray, the pinnules and regenerated arms white.

The third specimen, from *Blake* station 219, according to Hartlaub, is to be referred to this variety in spite of some deviations. This is a cotype of Carpenter's *Antedon pourtalèsi* (see page 309), but it differs markedly from the holotype.

The form of the centrodorsal resembles that of the specimen from *Blake* station 241, except that here there are prominent interradial ridges that are only indicated in that specimen; weaker radial ridges are also present so that the cirri stand in columns, three to a column. This regular arrangement of the cirri is indicated in both the other specimens.

The radials are only partially visible, near the interradial processes of the centrodorsal. All the IIBr series preserved are 2, and there are two IIIBr 2 and one IIIBr 4(3+4) series. The ornamentation of the division series, consisting of a high development of the marginal frills of the ossicles as seen in the specimen from *Blake* station 241, is in general missing only here and there, small spines or dentations standing out prominently along the edges of the ossicles. There is a median ridge on these ossicles, but otherwise the dorsal surface is smooth. On a few of the elements of the IIBr series there are already the stout spines that are so characteristic of the distal borders of the brachials.

The ornamentation of the first 10 or 12 brachials is not so regular as in the specimen from *Blake* station 272, and is in part composed of several pointed spines, which are stouter than those on the specimen from *Blake* station 241.

The distribution of the syzygies agrees with that in the first two specimens. In the two preserved arms arising from a IIBr axillary the first syzygy is between brachials 1+2 and the second is between brachials 4+5 or 6+7. Also on arms arising from IIIBr axillaries there appears usually to be a syzygy between brachials 1+2.

The pinnules, which are poorly preserved, appear not to differ significantly from those of the two other specimens. The carination of P_1 is hatchetlike or convex as in the specimen from *Blake* station 241.

The reddish color is not present in this specimen which is gray, the base darker, the arms lighter.

The arms have an estimated length of 75 mm.

Localities.—*Blake* stations 219, 241, 272.

Geographical range.—Barbados, St. Lucia, and Carriacoú (Grenadines).

Bathymetrical range.—From 139 to 298 meters.

Thermal range.—From 11.67° to 18.20° C.

CRINOMETRA BREVIPINNA var. ORNATA (Hartlaub)

Antedon brevipinna var. *ornata* Hartlaub. Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 348 (description; *Blake* station 249), pl. 4, fig. 6, pl. 12, fig. 4.

Description.—A large and magnificent specimen with numerous stout and richly ornamented arms, in spite of many deviations, was considered by Hartlaub as a further development of the *brevipinna* type.

The centrodorsal is rather flat with a typical dark-colored bare dorsal pole which is beset with fine tuberosities. The interradial processes are well developed. The cirri are about XXXIII; only one cirrus with 15 segments is entire. In this the first two segments are short, the remainder elongated, and an opposing spine is present.

The radials are wholly concealed. The IBr_1 are unusually flat. The similarly flat IBr_2 (axillaries) are more rhombic than pentagonal, with a slight posterior process. Of the 10 IIBr series present, five are 2, one is composed of a single axillary ossicle, and four are 4(3+4). The ossicles are in general flat. The axillary is often of irregular shape, with one side high and the other low. There are several IIIBr 2 series, one IIIBr 1 series, and one IIIBr 2(1+2) series. Two IVBr 2 series are present.

There are 32 arms. In the shape of the lower brachials there is a double variation. First, there are about three transverse articulations, then about six diagonal, then two or three transverse, the remainder being diagonal. The shape of the brachials changes in accordance with the direction of the articulations. Toward the arm tips the brachials have a scalelike overlap.

The ornamentation differs from that of the two specimens described as var. *coronata* in being more richly developed as a result of greater coarseness. On the IBr series there is a slight granulation or tuberculation, only the distal edge of the IBr_2 (axillaries) showing a dentation. Usually the IBr axillary has a ridgelike or sharply tubercular median ornamentation. This is also present on the IIBr series in the shape of one or several erect and usually sharp tubercles, though granules or coarse spines are here and there present on the dorsal surface, especially on the sides. The distal borders of the axillaries, sometimes also the proximal border, like the distal border of the $IIBr_2$ (in IIBr 4[3+4] series) and the lateral borders of the $IIBr_1$ are everted and dentate. The ornaments of the IIIBr series have already developed the entirely spiny or dentate character. The ornamentation of the lower brachials of this specimen shows the *Spinosa* type in its highest development. The brachials bristle with pointed spines and sharp teeth that are sometimes single, sometimes more or less coalesced. Especially favored are the distal edges of the brachials; particularly from the fourth to about the tenth brachial the surface of the brachials is beset with smaller teeth and spines. On syzygial pairs there are only two transverse rows of spines, one directly beneath the other. The distal limit of this ornamentation varies on different arms from the tenth to the seventeenth brachial. On the surface of the brachials immediately following are found only isolated and sometimes obsolescent granules; their distal ends are at first beset with rather high spines which later become smaller and more sparse, and finally disappear toward the arm tips.

The sequence of the syzygies is rather variable. In arms arising from a IIBr axillary the first syzygy may be between brachials 1+2, followed by another between brachials 4+5; or these two syzygies may be absent, in which case the first syzygy is found between brachials 11+12 or 14+15. A syzygy from between brachials 19+20 to between brachials 23+24 appears to follow regularly, and the next follows at intervals of from 6 to 9 muscular articulations. On arms arising from a IIIBr axillary the first syzygy as a rule is between brachials 1+2, often followed by another between brachials 3+4. The syzygy between brachials 1+2 is rarely absent, but if it is the first syzygy is between brachials 3+4. The next syzygy, which is sometimes the second and sometimes the third, is from between brachials 13+14 to between brachials 23+24, and the distal intersyzygial interval is from 4 to 14, usually 7–10, muscular articulations.

P_D is 15–17 mm. long and is composed of 30–40 short segments of which the first 8–12 are much broadened and are keeled into a hatchet-shaped edge on one side. P_1 is 10–12 mm. long with about 30 segments of which the lowest 6–8, with the exception of the two first, show the typical carination. The length of the lower pinnules appears to vary, as on one arm Hartlaub found P_1 about 11 mm. long and P_2 15 mm. long with about 28 segments. In general the length of the following pinnules as far as P_4 and the number of their component segments decreases. P_4 is 8–10 mm. long with 15–20 segments. In the range of the ornamentation of the arms the keels of the first 2–4 pinnule segments are often beset with spines or teeth. The pinnules of the middle of the arms, after the tenth brachial, are 6–7 mm. long with 10–12 segments of which the two first are short and those following elongate. Where gonads are present the third and fourth segments are markedly broadened. Toward the arm tips the pinnules become more slender and their length and the number of component segments increases. The distal pinnules are about 10 mm. long with up to 15 segments.

The ambulacral plating consists of prominent side and covering plates. The sacculi are of medium size and rather conspicuous. The disk is about 20 mm. in diameter and is only slightly incised.

The arm length is estimated at 140 mm.

In alcohol the disk is gray-brown, the skeleton light gray. The centrodorsal is somewhat darker than the other parts. Only the cirri are white.

Locality.—*Blake* station 249.

Geographical range.—Known only from off Grenada.

Bathymetrical range.—Known only from 479 meters.

Thermal range.—One record, 8.33° C.

CRINOMETRA BREVIPINNA var. GRANULOSA (Hartlaub)

Antedon brevipinna var. *granulosa* Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 323 (in key), p. 351 (description; *Blake* station 45), pl. 11, figs. 1, 2.

Description.—Hartlaub said that a specimen from *Blake* station 45 with an arm length estimated at about 125 mm., together with a detached postradial series of similar character from another individual, in their ornamentation recall the postradial series of a specimen of *granulifera* from the same station, especially the larger of Pourtalès' type specimens. He said that this was especially remarkable because in this specimen, in addition to the IIBr 2 series, there is one IIBr 4 series and one IIBr 3 series, in both cases without syzygies. He remarked it is possible that, in spite of many deviations from Pourtalès' type specimen, this individual represents a transition form between *brevipinna* and *granulifera*.

The centrodorsal is subhemispherical with a flat excavated bare dorsal pole. The interradial processes are well developed. The number of cirrus sockets is about 40.

The cirri, except for a single slender one with 17 segments, are broken off. They are apparently very slender, in contrast to those of var. *tuberosa*.

The radials are not visible. The IBr_1 are very flat, bowed downward in the middle. The IBr_2 (axillaries), also rather short, are rhombic; the proximal border is somewhat convex, though without forming a typical posterior process, from the IBr_1 outward to the fourth brachial on arms arising from a IBr axillary, or to the second brachial on arms arising from a IIBr axillary. The IIBr series are usually 2; one is 4(3+4) and another is 4, without a syzygy. Several ossicles are irregularly formed, or appear as if broken in pieces. Of the IIIBr series, two are 2 and one is 4(3+4). On the additional postradial series found with the specimen all the IIBr and IIIBr series are 2. The surface of all the ossicles of the division series, as in the case of Pourtalès' type specimen of *granulifera*, bears coarse and very flat granules; in the median line there is a larger and somewhat higher granule, or a slightly raised median ridge. The borders of the ossicles are smooth.

There are 20 arms, of which 3 arise from IBr axillaries. As far as the fourth or sixth brachials the articulations are transverse. The brachials here are discoidal, broader than long. Then follow four or five bluntly wedge-shaped brachials, then usually two or three somewhat longer and approximately discoidal with transverse articulations, after which the brachials again become wedge-shaped, and farther out more triangular. The surface of the brachials as far as the fifteenth or seventeenth is also granulated, but here the granules are smaller and lower than those on the division series, and on many arms are more in the form of small teeth.

In arms arising from a IBr axillary the first syzygy is between brachials 3+4, immediately followed by another between brachials 5+6. On arms arising from a IIBr or IIIBr axillary the first syzygy is usually between brachials 1+2, the second usually between brachials 3+4, the third from between brachials 6+7 to between brachials 15+16, and the distal intersyzygial interval, so far as may be judged from the few better preserved arms, is 4–16, usually 6–9, muscular articulations.

On one arm arising from a IBr axillary P_1 is 10 mm. long with 21 short segments; on another it is 15 mm. long with about 35 segments; thus P_1 is rather variable. Only one, three-edged, P_D with 30 segments is present; the first 12 to about 18 segments, except for the basal, are strikingly broad and keeled. In this pinnule about six of the proximal segments are thick, strongly broadened, and at first narrowly, but from the third or fourth onward more broadly, keeled. In this, as in other respects, it resembles P_D in the second Martinique specimen of *granulifera*, without being wholly in agreement with it. P_1 on arms arising from IIBr or IIIBr axillaries is very variable, in individual cases about 10 mm. long with about 20 segments. In general the pinnules following decrease in length and in the number of their component segments to about P_4. The pinnules of the middle of the arm are unfortunately very poorly preserved; a few uninjured ones are 4–6 mm. long with 12–14 segments, often only 9 or 10, of which the two first are short, triangular, the next two or three broadened over the gonads and quadrangular, and those following elongate. On the single postradial series on which they may be made out the distal pinnules become longer again and, except for the first two segments, are very slender, about 9 mm. long with 13–15 segments.

The ambulacral plating consists of prominent side and covering plates. The sacculi are rather large and conspicuous. The disk is about 12 mm. in diameter, dark brown, and deeply incised.

In alcohol the centrodorsal is dark gray brown, the rest of the skeleton lighter and gray.

Locality.—*Blake* station 45.

Geographical range.—Northwest of the Dry Tortugas, Florida.

Bathymetrical range.—Between 731 and 1,097 meters.

Thermal range.—One record, 5.0° C. (at 1,097 meters); this is undoubtedly too low.

CRINOMETRA BREVIPINNA var. GRANULIFERA (Pourtalès)

[See vol. 1, pt. 2, figs. 304, 305, p. 223, fig. 674, p. 335.]

Antedon granulifera Pourtalès, Bull. Mus. Comp. Zool., vol. 5, No. 8, 1878, p. 215 (description; *Blake* station 45).—P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 241 (in key), p. 380 (Caribbean Islands; 101–120 fathoms [*Blake* stations 45 and 157]).—Hartlaub (in part), Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 298 (redescription; *Blake* stations 34, 45, 101 [but not the second specimen from Martinique, which is *gemmata*]), pl. 1, figs. 24, 25, pl. 5, figs. 1, 2, 4, 6, 10–13, pl. 12, figs. 2, 6, 7.

Charitometra imbricata A. H. Clark, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 266 (new name for *Antedon granulifera* P. H. Carpenter, [erroneously] supposed not of Pourtalès; specimen with three consecutive pinnules on the same side, with no locality given).

Crinometra granulifera A. H. Clark, The Danish *Ingolf*-Exped., vol. 4, No. 5, Crinoidea, 1923, p. 40 (range).—H. L. Clark, Mem. Soc. Cubana Hist. Nat., vol. 15, No. 1, 1941, p. 9 (*Atlantis* stations 2999, 3303, 3465, 3478, 3482).

Description.—Hartlaub redescribed *Antedon granulifera* on the basis of two much broken specimens and a detached disk from *Blake* station 45, apparently the type material of Pourtalès, and two very mediocre specimens with detached arms from *Blake* station 34. The two better specimens together with various pieces of arms and a calyx from off Martinique also regarded by Hartlaub as representing *granulifera* are herein referred to var. *pulchra*.

Hartlaub said that Carpenter evidently had several specimens from the Blake collection that he referred to *granulifera* besides Pourtalès' types, and he believed that he considered as representing *granulifera* the specimens that he (Hartlaub) described under that name, although no label in Carpenter's hand was found anywhere.

Hartlaub remarked that his material showed to an extraordinary degree the great variability of this form. He said that this variability is not confined alone to the outward habitus or to the ornamentation, but affects also those features which ordinarily show greater constancy, such as the distribution of the syzygies, the length of the proximal pinnules, the relative visibility of the radials, and so forth, and in these cases it is so extensive that at first it appeared to be impossible to give a specific diagnosis that he could consider as of real value and reliability on the basis of the specimens before him. Hartlaub considered it most practicable to give a detailed description of the individuals from which an appreciation of the true specific characters may be obtained.

Hartlaub noted that in a letter to him dated December, 1909, I had sent him some critical remarks on the proofs of his plates 1–10, and he found that I had described as new species several of the forms regarded by him as varieties of *granulifera*. Thus the second individual from Martinique as shown on plate 5, figure 8, I identified as my *Crinometra imbricata*, and the first specimen from Martinique as shown on plate 5, figure 3, I identified with my *C. pulchra*. Hartlaub said he need only remark that he held to his original opinion and hoped especially that his plate 12, which I did not see, would serve to justify it.

In the two specimens from *Blake* station 45, which were part of Pourtalès' original material, the centrodorsal is dome-shaped, the bare dorsal pole with traces of cirrus sockets. At the base of the centrodorsal are five small elevated interradial knobs.

The cirri are about XX, 15–20, from 8 to 23 mm. long. The three basal segments are thick, short, and cylindrical, those following elongate, the outermost shorter again and strongly compressed laterally. There are no dorsal spines, with the exception of the feebly developed opposing spine, but the distal ends of the segments are slightly overlapping.

The radials are short, though entirely visible, somewhat longer laterally than in the median line, with a small knob in the middle of the dorsal surface; they are in close contact laterally. The IBr_1 are somewhat longer than the radials; there is no noteworthy elevation on the articulation with the IBr_2 (axillaries); they are laterally in contact. The IBr_2 (axillaries) are pentagonal, laterally as long as the IBr_1. The IIBr series are either 2 or 4(3+4). In the smaller specimen there are three IIBr 2 and two IIBr 4(3+4) series, in the larger five IIBr 4(3+4) series and one IIBr 2 series. In the larger specimen the ossicles as far as the $IIBr_2$ have rather sharply flattened sides; in the smaller this feature at the best is only suggested. The IIIBr series are 2, though according to Carpenter they are 2(1+2); Hartlaub said that following a IIBr 2 series the two elements of the IIIBr series gave the impression of being united by muscular articulation. The surface of all the ossicles of the division series in the larger specimen is flat and coarsely granulated, and in the middle of the dorsal surface there is distinguishable a stouter granule resembling that on the radials. This alone is present on the smaller specimen, the rest of the ossicles being smooth. There are no synarthrial tubercules.

The larger specimen has 21, the smaller 19, rather slender arms. The first brachials are in close lateral apposition. The lower approximately discoidal brachials as far as about the eleventh in the larger specimen have strongly produced distal ends which are partially beset with smooth sharp spines. On some arms these brachials are markedly saddle-shaped (that is, centrally constricted) and spiny, this feature being much less developed on others. Quite characteristic it is for their surface to have irregular cavities, and as a result a grooved or furrowed appearance. A central small knob may be distinguished on all the brachials except the more saddle-shaped ones with a spiny edge. These small knobs form a continuous row as far as the radials. The distal edges of the brachials often have a spine or process on each side. The proximal brachials of the small specimen are much smoother; only here and there may there be seen a pronounced grooving of the surface and a small knob in the middle. The brachials following are triangular with arched distal ends, and have smooth surfaces. Toward the arm tips they have a tilelike overlap, and the distal edge here is slightly convex.

In arms arising from a IBr axillary the first syzygy is between brachials 3+4, in arms arising from a IIBr or IIIBr axillary between brachials 1+2, this being often followed by one between brachials 3+4 or between brachials 4+5. The next syzygy is usually at about the twenty-first brachial, those following often at intervals of 9 or 10 muscular articulations, and farther out at intervals of about 6 muscular articulations. In the smaller specimen, in arms arising from a IIIBr axillary the syzygies are at shorter intervals, for instance between brachials 1+2, 4+5, 17+18, 23+24, 29+30, and 34+35; or between brachials 1+2, 6+7, 15+16, 21+22, and 27+28; an arm arising from a IBr axillary has the first syzygy between brachials 3+4, the next between brachials 6+7, and the third between brachials 22+23.

The lowest pinnule in the larger specimen is on the $IIBr_2$ if the division series are 4(3+4), and there is always a pinnule on the second brachial. Only a P_1 is preserved entire. It is 12 mm. long with 30 short segments of which the lower are broad and carinate. P_2 is markedly shorter and has only 17 segments. The pinnule following on the same arm is not complete. P_4 is 5 mm. long with about 12 segments. The lower segments of all these pinnules are broadened, but there is no clearly marked carination. On other arms the lower segments of these same pinnules are sharply carinate, which appears to be the general rule. The distal pinnules have usually 13 segments, most of which are elongate and cylindrical. In the younger specimen a carination of the lower pinnules is scarcely present. On the larger it reaches to about the sixteenth brachial.

The ambulacra of the pinnules are provided with side and covering plates, and with numerous inconspicuous sacculi. The disk is somewhat incised. In the larger specimen it is scarcely 10 mm. in diameter, in the smaller 6 mm. It is thickly beset with calcareous granules which are rounded or elongate and are mostly not in contact with each other.

The larger has the arms with an estimated length of 100 mm., the smaller of 60 mm.

In alcohol the skeleton is brownish white, the disk and soft parts of the arms dark brown.

Hartlaub pointed out that Pourtalès' original description gave the number of arms as 20, with a spread of 200 to 230 mm. (or an arm length of 100 to 115 mm.). It differs from his description in stating that the radials are entirely concealed, and that at about the middle of the arm the brachials are frequently, though not always, ornamented with beadlike tubercles of which the middle one is the largest. Pourtalès said that the first pinnule is the longest and very broad on the first brachial, by which he probably meant the epizygal of the first syzygial pair.

Hartlaub remarked the absence of any statement regarding the number or state of preservation of Pourtalès' specimens. In view of Hartlaub's observations the most striking deviation is that the ornamentation of the arms is confined to the middle, while he found it developed only on the arm bases. Pourtalès' statements regarding the proximal border of the saddle-formed brachials are in complete agreement with his observations.

The differences between Pourtalès' original description and Hartlaub's redescription are probably explained by a specimen in the Museum of Comparative Zoology (No. 267) from *Blake* station 45 which is labeled "*Antedon granulifera*" and is probably the one on which Pourtalès' original description was mainly based; it was not seen by Hartlaub.

In this specimen the longest cirrus has 18 segments and is 33 mm. long and rather slender. The IIBr series are of 4 ossicles of which the two outer are not united by syzygy. The division series and arm bases are perfectly smooth dorsally, rather strongly convex, and sharply flattened laterally. The earlier brachials have prominently and rather abruptly everted ends, and usually a more or less prominent tubercle in the middle of the distal edge.

Both the specimens from *Blake* station 34 are very poorly preserved. Almost all the arms are broken off close to the base. The larger lacks the disk. This specimen shows the closest agreement with that from *Blake* station 45, while the smaller is remarkable for its more strongly spiny ornamentation.

The larger specimen has well preserved cirri, one of which exceeds the others, reaching a length of 35 mm. Especially to be noticed, according to Hartlaub, is the fact that in this specimen the small prominences in the middle of the ossicles of the division series are not knoblike, but take the form of feeble elongate ridges. This type of ridge is found highly developed in a specimen from Montserrat (*Blake* station 157) that Carpenter has apparently referred to *granulifera* but which Hartlaub described under the name of *Antedon angusticalyx* (see var. *angusta*, p. 335). There is a single well preserved P_1. It is about 12 mm. long and is composed of 25 segments which from the ninth onward are elongate. The lowest segments, like those on the two following pinnules, are carinate. The pinnules immediately following have more uniform, strongly broadened, segments. The elongate form of the pinnule segments forms a very noteworthy contrast to the conditions in the specimen from *Blake* station 45. Hartlaub remarked that if we wish to form a correct estimate of the range of forms in such a variable type as *granulifera* we must present the small individual variations with the greatest care.

In the larger specimen from *Blake* station 45 Hartlaub noted on individual arms saddle-shaped brachials with spiny ends. In the smaller specimen from *Blake* station 34, of which the arms are about 75 mm. long, he found the distal ends of all the ossicles from the IBr axillary to about the thirteenth brachial beset with small, stout, erect spines. Isolated small spines are also found on the dorsal surface. On the ossicles of the division series there is a small knoblike elevation in the middle. The proximal ends of the ossicles as a rule are not spiny. A saddle-shaped concavity of the dorsal surface is nowhere present.

Hartlaub said that this specimen shows a transition to the one from Martinique. The feature of the spiny edges, which in the specimen from *Blake* station 45 is only to be noticed in traces here and there, is so much further developed in the Martinique specimen that it totally alters the general appearance. This Martinique specimen is herein regarded as belonging to var. *gemmata* (see page 318).

In the larger specimen from *Blake* station 34 Hartlaub counted seven IIIBr series, but apparently more were originally present. The number of arms he estimated as at least 30. The radials are only slightly visible in the interradial angles. Of the IIBr series, one is 2 and one is 4(3+4).

The smaller specimen from *Blake* station 34 had apparently about 20 arms. Two of the IIBr series are 2. There are no IIIBr series. The radials are wholly visible. P_D is predominantly flattened laterally. The cirri are strikingly short.

The best specimens, according to Hartlaub, were two from off Martinique collected by Captain Cole apparently when on the cable repair ship *Investigator*. They far exceed those from *Blake* stations 45 and 34 previously described, and because of the relatively good state of preservation of their arms permit of a fairly close estimate of the arm length. So different are they that they show in its highest development each feature of the ornamentation which in the others, perhaps because of their younger age, is only indicated. The second of these specimens is described under var. *gemmata* (see page 319).

The first specimen from Martinique, according to Hartlaub, shows a striking similarity to *Charitometra basicurva* in the ornamentation of the lower brachials. These ossicles are strongly saddle-shaped, and their greatly produced edges are beset with sharp, stout, and erect spines. The characteristic granulation which appears on the surface of the division series in the first described specimen from *Blake* station 45 is here entirely lacking.

There are 21 arms about 140 mm. long. One of the IIBr series is 2. The arms have syzygies between brachials 1+2 and also between brachials 3+4. One IIIBr 2 series follows a IIBr 4(3+4) series, developed internally.

The radials are slightly visible here and there. The IBr_1 are short; their proximal border is rather strongly convex and laterally somewhat notched. Such notches, interrupted by small convexities, were found more extensively in the two specimens from *Blake* station 157 determined as *Antedon angusticalyx* by Hartlaub (=var. *angusta*, page 335). The lateral borders of the IBr_1 are somewhat broadened, this broadening resulting in part from an incision, often very strong, by the IBr axillary. A quite similar relationship exists between the $IIBr_1$ and $IIBr_2$.

The small pinnules of the ninth–eleventh brachials, which are about 5 mm. long, show a very marked broadening of the third–fifth segments, especially of the fourth. The lowest pinnules are not visible because of the very close apposition of the arm bases.

This specimen is the stoutest of all those seen by Hartlaub, and the estimate of an expanse of 380 mm. (an arm length of 190 mm.) is certainly not too high.

Another specimen from Martinique was apparently utilized by Carpenter for a preparation of the calyx. The five radials, separated from the calyx, are fairly well preserved.

This specimen stands out from the others in that there is no conspicuous contrast between the proximal and more distal brachials in respect to conspicuous ornamentation. The lower brachials are rather strongly saddle-shaped, but their dorsal surface is smooth, and their distal ends are not beset with erect spines but are simply dentate with sharp recumbent points. The arms are very slender and long. Long, slender, and very flexible arms, according to Hartlaub, appear to be especially characteristic of var. *granulifera.*

The sequence of the syzygies agrees with that of the second specimen from Martinique, herein referred to var. *gemmata* (see page 319). On several arms the second syzygy follows the first after a few brachials; for instance, on one arm it is between brachials 6+7, on another between brachials 10+11.

P_D resembles the same pinnule in the smaller specimen from Montserrat (*Blake* station 157) that Hartlaub referred to *angusticalyx* (=var. *angusta*, p. 335). The basal segments of the pinnules are broad, but from about the sixth onward they abruptly become slender.

Summarizing the significant features held in common by the six specimens that he referred to *granulifera*, Hartlaub listed these as: The form of the centrodorsal; the number and form of the cirri and of their segments; the occurrence exclusively or mainly of IIBr 4(3+4) series; short segments in the division series and arms; the position of the first brachial syzygy between brachials 1+2 in arms arising from a IIBr series; carinate proximal pinnules with short broad segments; and restriction of the brachial ornamentation to the arm bases.

The specimens referred to *imbricata* may be described as follows. The centrodorsal is hemispherical bearing 10 or 15 usually very definite columns of cirrus sockets; the bare polar area is comparatively small.

The cirri are XXV–XXX, 17–23 (usually about 20), from 25 to 30 mm. long, and are comparatively slender. The first four segments are short, the fourth is about as long as broad, and the remainder are about half again as long as broad; the distal ends are somewhat prominent and overlap slightly dorsally.

The ends of the basal rays are visible as rounded tubercles in the angles of the calyx.

The radials are concealed, or partially visible as small tubercles on either side of the basal tubercles. The IBr_1 are very short with the proximal border convex. The IBr_2 (axillaries) are very broad and low, about three times as broad as long. The IIBr series are 4(3+4) and are very short. The IIIBr series are 2(1+2), internally developed in 1,2,2,1 order. The distal angles of all the axillaries are remarkably low. The division series and first five brachials are in close lateral apposition and are sharply flattened laterally. The outer side of each postradial series is separated slightly from that of the postradial series adjoining by the prominent dorsal carination of P_D, the dorsal portion of P_D being partially visible between the rays.

There are 18–25 (usually about 20) arms about 160 mm. long. The arms are slender and of approximately uniform width. The first four brachials are very short and discoidal; the next four or five are rectangular, those following becoming triangular, about as long as broad, and remaining very uniform to the arm tips. The edges of the elements of the division series and of the first four brachials are smooth, those of the brachials following strongly overlapping. There is no trace of carination or other surface ornamentation. The arms are rather sharply compressed laterally in the basal half.

Syzygies occur between brachials 1+2 and 3+4, again from between brachials 7+8 to between brachials 13+14, and distally at intervals of 5–9 (usually 6 or 7) muscular articulations.

P_D is 11 mm. long with 35 or more short segments of which the basal 7 or 8 have broad dorsal keels which gradually die away distally, though the pinnule is sharply carinate to the tip. The pinnule is broad and much flattened in the basal half, then becomes gradually narrower, ending in a slender and delicate tip. P_1 is similar but about 1 mm. shorter with about 25 segments of which the distal are proportionately longer and somewhat broader. P_2 is 8 mm. long with about 20 segments which are about as long as broad; the pinnule tapers evenly, the basal segments being very slightly, when at all, carinate. P_3 is similar to P_2 but rather shorter with larger segments. The pinnules following are shorter still and have the third-fifth segments laterally broadened, protecting the gonads. Distally the pinnules gradually increase in length, the distal pinnules being 11–12 mm. long with about 22 segments of which the first is short, the second is almost triangular, and those following are about half again as long as broad; all have prominent distal edges.

The color in alcohol is yellowish white.

Two specimens from *Albatross* station 2154 described (in manuscript) under the name *inornata* seem to belong here. The centrodorsal is flattened hemispherical with the small bare polar area more or less rugose. The cirrus sockets are arranged in two irregular rows, with a tendency toward two columns.

The cirri are XX, 20, 30 mm. long, and are rather slender. The first segment is short, the second is twice as broad as long, the third is nearly as long as broad, and those following increase in length to the sixth which, with the remainder, is somewhat over twice as long as broad. The penultimate segment is slightly less in width than those preceding, though of the same proportions. The outermost six or seven segments have the median portion of the distal dorsal edge slightly thickened; the distal ends of all the segments are slightly and gradually enlarged. The opposing spine is represented by a small terminally situated tubercle directed obliquely forward. The terminal claw is about two-thirds the length of the penultimate segment, moderately slender and evenly curved.

The ends of the basal rays are visible as prominent strongly rounded tubercles in the angles of the calyx.

The radials are just visible beyond the rim of the centrodorsal. The IBr_1 are short, about four times as broad as long. The IBr_2 (axillaries) are broadly pentagonal, three times as broad as long, with the lateral borders as long as those of the IBr_1. The IIBr series are 4(3+4). The IIIBr series are 2, though seldom present. The division series are moderately and evenly convex dorsally, in close apposition and sharply flattened laterally. P_D is not visible exteriorly.

The 18 or 19 arms are about 100 mm. long and resemble those of the specimens described as *imbricata*. The first twelve brachials are flattened laterally. The arms are evenly rounded dorsally, without ornamentation. On the fifth or sixth the brachials begin to develop overlapping distal ends, which soon become prominent.

The pinnules resemble those of the specimens described under *imbricata*, the lower being strongly carinate.

The disk is completely covered with a pavement of very small plates. Side and covering plates are well developed along the brachial and pinnule ambulacra.

The color in alcohol is white, the division series and arm bases as far as the third brachial brownish.

Hartlaub described the skeletal elements of the calyx from a preparation consisting of the centrodorsal and radial pentagon made by Carpenter which he found in a special vial with the Martinique specimens. This description by Hartlaub should be compared with the description of the centrodorsal and radial articular faces of *Crinometra brevipinna* var. *insculpta* given in Part 2, pp. 48, 49, figs. 76, 77, p. 53.

Hartlaub says that the ventral surface of the centrodorsal is rather sharply pentagonal, in good agreement with that of *Perissometra inaequalis* as figured by Carpenter. The radial depressions are more or less sharply triangular, because the raised borders of the basal grooves in part come into contact with each other at the entrance to the central cavity of the centrodorsal. The circumference of the entrance to the central cavity is sharply pentagonal.

The dorsal surface of the radial pentagon shows a well developed basal star. The inner ends of the rays are united with the rosette by ring-shaped bridges; the sharply pointed outer ends reach to the border of the radial pentagon. The rays of the basal star are three-edged; inwardly they are in broad union with the rosette. With sufficient treatment with caustic potash it is possible to isolate the basal rays with the rosette. The isolated basal rays show on their inner end two perforations—the nerve canals. All these features correspond in general to the same features in *Perissometra angusticalyx* and in *P. inaequalis.*

But considerable differences from *P. angusticalyx* and *P. inaequalis* are shown in the ornamentation of the outer articular face of the radials. Especially striking, according to Hartlaub, is the absence of a median ridge separating the two muscular fossae. This is present in most endocylic comatulids, and also in *Perissometra angusticalyx* and *P. inaequalis.* Instead of this, there is, as in the Comasteridae, a median groove that begins between the interarticular ligament fossae and farther out broadens into an unpaired muscular fossa. This muscular fossa, in contrast to the conditions in *Perissometra angusticalyx* and *P. inaequalis,* is not bordered by a sharp ridge but is separated from the two small interarticular ligament fossae by a broad elevation which in places is obscure. On the other hand, the dorsal ligament fossa lying below the opening of the radial nerve canal is large and well developed, as in *Perissometra inaequalis.* The angle of inclination of the joint face is moderate and less strong than in *P. angusticalyx,* and in *P. inaequalis.* Finally, the dorsal surface of the radial pentagon has approximately the same size as the ventral surface of the centrodorsal. In this respect Hartlaub points out that there is agreement with *P. inaequalis,* while in the specimen of *P. angusticalyx* figured by Carpenter the ventral surface of the centrodorsal is larger than the dorsal surface of the radial pentagon. Hartlaub said that in general it should be noted that as yet it has not been determined to what degree of variation the relation between the radial pentagon and the basal star is subject, and therefore to what degree slight deviations in this region are of systematic significance.

The preparation figured by Hartlaub certainly is not normal; possibly it had become partially decalcified.

Localities.—*Blake* stations 34, 45, 101, 157; *Investigator,* Martinique; *Albatross* stations 2327, 2319–2350; *Caroline* stations 43, 102; *Atlantis* stations 2999, 3303, 3465, 3478, 3482; "Caribbean Islands, 185–219 meters" (*Blake* stations 45 and 157) (Carpenter).

Geographical range.—From the Yucatán Bank, southern Florida, and Cuba to Martinique.

Bathymetrical range.—From 185 to 475 meters.

Thermal range.—One record, 16.53° C.

Remarks.—Dr. H. L. Clark said that the 15 specimens of *granulifera* secured by the *Atlantis* were compared with Pourtalès' type (M. C. Z., 267) and there is no doubt of their identity. The only noticeable difference is that in the type the distal cirrus segments are distally conspicuously wider than proximally, while in the *Atlantis* material the projection of the lower (i. e., dorsal) distal margin is not so conspicuous. But the *Atlantis* specimens show some diversity in this detail. The type has the arms about 100 mm. long; several of the *Atlantis* specimens are larger, with arms 125–150 mm. long. The type still retains a distinct dull purplish brown color, while the *Atlantis* specimens are much more nearly white, especially when dry.

CRINOMETRA BREVIPINNA var. PULCHRA A. H. Clark

Plate 30, Figure 91

[See also vol. 1, pt. 2, fig. 682, p. 338.]

Crinometra pulchra A. H. Clark, Proc. U. S. Nat. Mus., vol. 36, 1909, p. 644 (description; *Albatross* stations 2319–2350); U. S. Nat. Mus. Bull. 82, vol. 1, pt. 2, 1921, fig. 682, p. 338.

Description.—The centrodorsal is thick-discoidal, the sides more or less convergent distally, with the bare polar area 3–5 mm. in diameter and more or less tubercular. The cirrus sockets are arranged in three very irregular marginal rows.

The cirri are XX–XXIV, 18–20, from 30–40 mm. long, and moderately slender. The first segment is very short, the second is longer, the third is longer than the second, the fourth is rather more than twice as broad as long, and the remainder are approximately equal, nearly or quite half again as long as broad. The penultimate segment is twice as long as broad, somewhat less in width than those preceding. The cirri are slightly compressed in the distal half. The distal ends of the segments are slightly enlarged, and in the distal third there is a slight enlargement of the distal dorsal edge. The opposing spine is represented by a small blunt tubercle terminally situated and directed obliquely forward. The terminal claw is short, about two-thirds as long as the penultimate segment, stout and strongly curved.

The ends of the basal rays are visible as rather large tubercles in the angles of the calyx.

The radials are entirely concealed, or at most form a gablelike ridge over the ends of the basal rays. The IBr_1 are very short, chevron shaped or crescentic, or entirely concealed. The IBr_2 (axillaries) are large, rhombic, from half again to twice as broad as long; the edges all around are prominent, and there is a moderate rounded median carination. The IIBr series are 2, with the first element very short and the axillary about twice as broad as long and rhombic. The IIIBr series are 2, similar to the IIBr series, developed interiorly in 1,2,2,1 order. The division series are perfectly smooth dorsally and are in close apposition all around the calyx; the edges of the component elements are slightly prominent, and the axillaries have a slight broadly rounded median ridge, most pronounced on the first. One specimen has one IIBr series and one IIIBr series 4(3+4).

The 30 arms are 150 mm. long and resemble, except in ornamentation, those of related forms. After the third or fourth the brachials develop strongly overlapping distal ends the middle of which is swollen into a broad tubercle which may extend proximally to the lower edge. This feature disappears after about the thirtieth brachial.

P_1 is 11 mm. long with 30 segments, evenly tapering and becoming slender and flagellate distally; the basal segments are about four times as broad as long, the outer about as long as broad. P_2 is of the same length as P_1 and similar to it, but slightly more slender. P_3 is 9 mm. long and similar to P_2. P_4 is 9 mm. long, very slightly stouter basally than P_3. The pinnules following become gradually shorter with fewer segments of which the basal become gradually more expanded. P_8 is 7 mm. long with 15 segments of which the third, fourth, and fifth are much broadened and the sixth is trapezoidal, the pinnule from this point onward being slender with the segments about twice as long as broad. The pinnules following gradually decrease in length, P_{16} being 4 mm. long with about 12 segments of which the third–fifth are broadened and those following are somewhat longer than broad. From this point onward the pinnules gradually lose the expansion of the proximal segments and very slowly become more slender and increase in length. The distal pinnules are 7 mm. long. The gonads first appear on P_6 and rapidly increase in size, becoming large and semicircular in profile, laterally compressed, protected by the expansion of the pinnule segments and ventrally by the development of a pavement of perisomic plates. They disappear at about the end of the proximal third of the arms.

The disk is completely covered by a pavement of very small granular plates. Side and covering plates are strongly developed along the ambulacral grooves.

The color in alcohol is yellowish white, the division series and arm bases as far as the second brachials dark brown.

Localities.—*Albatross* stations 2154, 2319–2350; *Caroline* station 43; *Atlantis* station 3326.

Geographical range.—From northern Cuba to Puerto Rico.

Bathymetrical range.—From 484 (?439) to 567 meters.

Thermal range.—One record, 15.33° C.

Remarks.—Dr. H. L. Clark wrote that a small comatulid 10 mm. through the calyx with arms about 90–100 mm. long dredged by the *Atlantis* at station 3326 looks like a young *Crinometra*, but is clearly neither *granulifera* nor *insculpta*. He said that I had identified it for him as a young specimen of *pulchra*.

CRINOMETRA BREVIPINNA var. ANGUSTA, var. nov.

Antedon angusticalyx (not of P. H. Carpenter, 1888) Hartlaub, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 287 (description of two specimens from *Blake* station 157), pl. 4, figs. 3, 4, pl. 12, fig. 9, pl. 13, fig. 2.

Description.—The larger specimen from *Blake* station 157 described by Hartlaub under the name of *Antedon angusticalyx* has the centrodorsal dome-shaped with strongly developed interradial ridges and processes. The bare dorsal pole bears a few spines.

The cirri are XXI, 15–17. The first three segments are short, those following elongate. The longest are the fifth, sixth, and seventh, which are about 2 mm. in length. The profile of the dorsal edge of the cirri is proximally smooth but distally somewhat serrate, as in the distal portion the surface of the segments is somewhat produced at the distal end. The penultimate segment bears an opposing spine.

The radials are not visible. The IBr_1 are short; the proximal border has four rounded processes, two lateral above the interradial processes of the centrodorsal and two median above the border of two cirrus bases; the distal edge is deeply incised by the proximal process of the axillary. On the dorsal surface there is a moderately sharp median elevation. Laterally the IBr_1 are in close contact. The IBr_2 (axillaries), more rhombic than pentagonal, show a strong proximal process incising the IBr_1 which on the surface of the axillaries is sharpened in the form of a keel reaching its highest point on the synarthrial tubercle which it forms with the IBr_1. The axillaries are laterally free and have sharply flattened sides. All the 10 IIBr series are 4(3+4). The $IIBr_2$ has a proximally directed dorsal process which incises the distal edge of the $IIBr_1$ and forms the summit of a second synarthrial tubercle. The IIBr series have sharply flattened sides. There is a single IIIBr 2(1+2) series.

There are 21 arms about 150 mm. long (Hartlaub inadvertently gave the expanse as 30 mm. instead of 30 cm.). Only the two or three earliest brachials are rectangular; the second is somewhat shorter than the first, broader than long. The brachials then become bluntly wedge-shaped, then gradually triangular, as broad as long, toward the tips of the arms bluntly wedge-shaped again and at the same time longer.

The first syzygy is between brachials 1+2 except on a single arm arising from a IIBr axillary, on which it is between brachials 29+30. The position of the second syzygy is variable. Hartlaub found it between brachials 26+27, 31+32, 34+35, 35+36, and 42+43. Two especially well preserved arms arising from a IIBr axillary show the disposition of the following syzygies, which occur at very varied intervals. In one the second syzygy is between brachials 42+43, those following between brachials 53+54, 61+62, 66+67, 74+75, 86+87, 96+97, 102+103, and 123+124. In the other the second syzygy is between brachials 26+27 and those following are between brachials 43+44, 52+53, 61+62, 68+69, 77+78, 99+100, 118+119, 127+128, and 132+133.

P_D is 11 mm. long with about 30 segments of which the first four or five are somewhat stalked and broadened, though not strikingly differentiated from those following. The succeeding pinnules are 6–7 mm. long with 15–18 segments of which the two first, as in all the following pinnules, are short. P_3 bears a prominent gonad. The pinnule segments over the gonad are always broadened. The length of the genital pinnules varies. They are usually 5–6 mm. long with 9–14 segments. Distally the length of the genital pinnules appears gradually to decrease, but this cannot be determined with certainty because of the poor state of preservation. At about the twenty-eighth brachial the pinnules with prominent gonads stop. From about the thirty-sixth brachial, where they measure about 5 mm. in length, the pinnules increase in length again. In the distal third of the arms they are about 8 mm. long.

The disk is 12 mm. in diameter, rather deeply incised. According to Hartlaub it shows the ambulacral plating and ornamentation of *angusticalyx* as given in Carpenter's figures.

In alcohol the skeleton is pure white, the disk brownish white.

In the second and smaller specimen, which is only indifferently preserved, the centrodorsal is more flattened than in the larger. The dorsal pole is free of cirri, smooth, and deeply excavated. Interradial ridges are present, though strongly produced only in one place. Interradial processes are well developed.

The cirri are XXI; none of them are preserved.

The radials are short, though always visible. The IBr_1 are only slightly incised on the distal border; they are in close lateral apposition. The IBr_2 (axillaries) have only a weak posterior process. There is no ridgelike elevation of the dorsal surface of the IBr series, and the synarthrial tubercle is not so strongly developed. The IIBr series are more procumbent than in the larger specimen. The posterior process of the IBr_2 is weak, and a synarthrial tubercle is not present as it is in the larger individual. The sides of the IIBr series are sharply flattened. Most of the IIBr series are 4(3+4), but one is 2. On the $IIBr_2$ of another postradial series of which the axillary is lacking an arm has arisen through regeneration in which the first syzygy is not between brachials 1+2 but between brachials 31+32, the next being between brachials 53+54. There are no IIIBr series.

The 19 arms are estimated as 125 mm. long. They are smooth, as in the larger specimen. The first syzygy is between brachials 1+2. As in the larger specimen the second brachial is shorter than the first, and moreover lies somewhat deeper. The second syzygy is between brachials 28+29 and brachials 39+40, as in the larger specimen. Three poorly preserved arms show the spacing of further syzygies. On one arm syzygies occur between brachials 34+35, 51+52, and 59+60; on another between brachials 39+40 and 52+53; and on the third between brachials 33+34 and 54+55. The interval between the second and third syzygies is therefore from 13 to 21 muscular articulations.

P_D is about 8 mm. long with about 21 segments of which the first five or six are large, broad, and stalked, those succeeding more or less suddenly slender and elongate. Thus there is in general a basal broader section which is distinct from a more slender flagellate outer section, a feature that also appears in the third Martinique specimen of *granulifera* (see page 330). This difference is always greater than in the large specimen. P_1 is shorter, 5–6 mm. long. The contrast between the broad basal and flagellate outer sections has here already disappeared. The length of the pinnules following decreases. Those immediately succeeding are about 3 mm. long; those in the middle of the arms are 3–4 mm. long; these latter have, as in the larger specimen, two short basal segments followed by 6 or 7 elongate ones. The gonads are slightly developed, and the pinnule segments over them are, in relative fashion, modified as in the larger specimen.

The disk is 8 mm. in diameter, less deeply incised than in the other specimen.

In alcohol the skeleton from the centrodorsal to the first brachials inclusive is brownish white, the arms pure white. The disk is brownish white.

Hartlaub said that since the two specimens do not in all their features agree either with *Perissometra angusticalyx* or with *P. inaequalis*, and the larger specimen is more like *P. angusticalyx*, while the smaller is more like *P. inaequalis*, it would be natural to describe one as a variety of *P. angusticalyx*, the other as a variety of *P. inaequalis*. He did not do this because he considered that these two species are poorly established, and so he placed them under *P. angusticalyx*, which was the first described by Carpenter. He said it is remarkable that Carpenter, after he had described these two species at the same time, did not refer these specimens to one of them, but to *granulifera* Pourtalès, for which different specific characters hold good. This circumstance indicates, according to Hartlaub, that *angusticalyx* and *inaequalis* belong to the extremely variable species *granulifera* Pourtalès. But Hartlaub admitted that the material available to him was not sufficient to admit of a definite opinion.

Hartlaub noted that correlated with other features are the relationships of the individual skeletal pieces of the calyx of *inaequalis* and *angusticalyx* as described and figured by Carpenter.

The form of the centrodorsal, as far as the exterior is concerned, has been described. In regard to the relative size relations of the centrodorsal and the radial pentagon the smaller specimen, because of the visibility of the radials, agrees more with *inaequalis*. The remaining differences between *angusticalyx* and *inaequalis* are, judging from Carpenter's figures, not too significant, according to Hartlaub. In view of these figures, the ornamentation of the articular faces of the radials show insignificant differences. The muscular fossae in *angusticalyx* are smooth, in *inaequalis* ornamented with convex ridges. In both the median (vertical) ridge, and also the lateral ridges separating the muscular and interarticular ligament fossae are in agreement. The dorsal ligament fossa, because of the greater size of the radials in *inaequalis*, seems to be more considerable than in *angusticalyx*. The differences in the ventral surface of the centrodorsal in the two forms is trivial, those between the rosettes, according to Hartlaub, more significant. In Hartlaub's opinion Carpenter gave too much weight to the differences in the calyces of these two species. He remarked that in Carpenter's figures a complete covering of the centrodorsal by the radial pentagon is not shown, and, further, he does not understand how the comparison of individuals of different ages can be significant for the differentiation of the species.

Hartlaub closed his account of what he called *Antedon angusticalyx* from *Blake* station 157 with a few remarks on geographical distribution. He said that Carpenter's material of *angusticalyx* consisted of several specimens that had been dredged off the Meangis Islands, between the Moluccas and the Philippines. The material of *inaequalis* came from the neighborhood of the Kermadec Islands about 8° northnortheast of New Zealand, and also from the neighborhood of Kandavu, Fiji. He said that both species were heretofore known as Pacific forms, but he remarked that in contrast to this it is of interest that his material is Atlantic, from the Caribbean Sea, and noted that this is not without parallel in the genus *Antedon* (in the old sense), for, as an example, *A.* (*Tropiometra*) *carinata* is found at St. Lucia in the Caribbean Sea and has also been dredged in the Atlantic and Indian Oceans, as well as on the Pacific coast of America (but see Part 4b, pp. 319–323).

Locality.—*Blake* station 157.

Geographical range.—Known only from off Montserrat.

Bathymetrical range.—Known only from 219 meters.

DETAILS OF THE LOCALITIES WHERE CRINOMETRA BREVIPINNA AND ITS VARIETIES HAVE BEEN DREDGED

Atlantis station 2950; Bahamas, south of Great Bahama Island (lat. 26°14′ N., long. 78°43′ W.); 521 meters; February 3, 1938 [H. L. Clark, 1941].

Blake station 34; north of the Yucatán Bank (lat. 23°52′00″ N., long. 88°56′00″ W.); 731–1,097 meters; bottom temperature 5.0° C. (at 1,097 meters); 1878 [Hartlaub, 1912; A. H. Clark, 1918].

Albatross station 2353; between Yucatán and Cuba (lat. 20°59′00″ N., long. 86°23′00″ W.); 305 meters; bottom temperature 17.1° C.; coral; January 22, 1885 (2).

Blake station 45; northwest of the Dry Tortugas, Florida (lat. 25°53′00″ N., long. 84°21′00″ W.); 185 meters; bottom temperature 16.53° C.; 1878 [Pourtalès, 1878; Bell, 1882; P. H. Carpenter, 1881, 1883, 1888; Hartlaub, 1912; A. H. Clark, 1907, 1908, 1918, 1923] (1, M. C. Z., 267).

Atlantis station 3303; Cuba; off Playa Baracoa, Habana Province (lat. 23°05′ N., long. 82°33′ W.); 475 meters; March 23, 1939 [H. L. Clark, 1941].

Albatross station 2153; Cuba; off Habana (lat. 23°10′19″ N., long. 82°23′10″ W.); 517 meters; bottom temperature 13.2° C.; coral; April 30, 1884 (1).

Albatross station 2154; Cuba; off Habana (lat. 23°10′16″ N., long. 82°22′54″ W.); 567 meters; bottom temperature 15.33° C.; coral bottom; April 30, 1884 [A. H. Clark, 1909, 1918, 1921; Gislén, 1934] (4, U.S.N.M., 25472 [type of *margaritacca*], 25475 [type of *inornata*, Plate 32, Figure 98], 36078, 34644).

Albatross station 2155; Cuba; off Habana (lat. 23°10′21″ N., long. 82°22′44″ W.); 548 meters; coral bottom; April 30, 1884 (1, U.S.N.M., 34818).

Albatross station 2156; Cuba; off Habana (lat. 23°10′35″ N., long. 82°21′55″ W.); 508 meters; bottom temperature 15.44° C.; coral bottom; April 30, 1884 (1, U.S.N.M., 16898).

Albatross station 2166; Cuba; off Habana (lat. 23°10′36″ N., long. 82°20′30″ W.); 358 meters; bottom temperature 22.2° C.; coral bottom; May 1, 1884 (1).

Albatross station 2161; Cuba; off Habana (lat. 23°10′36″ N., long. 82°20′28″ W.); 267 meters; coral bottom; April 30, 1884 (1, U.S.N.M., 34947).

Albatross station 2337; Cuba; off Habana (lat. 23°10′39″ N., long. 82°20′21″ W.); 364 meters; coral bottom; January 19, 1885 (1, U.S.N.M., 34559).

Albatross station 2342; Cuba; off Habana (lat. 23°10′39″ N., long. 82°20′21″ W.); 367 meters; coral bottom; January 19, 1885 [A. H. Clark, 1909, 1918, 1921; Hartlaub, 1912; Clarke and Wheeler, 1917, 1922; Gislén, 1934] (7+, U.S.N.M., 25476 [type of *concinna*], 34553, 36246).

Albatross station 2347; Cuba; off Habana (lat. 23°10′39″ N., long. 82°20′21″ W.); 395 meters; coral bottom; January 20, 1885 (fragments, U.S.N.M., 34606).

Albatross station 2159; Cuba; off Habana (lat. 23°10′39″ N., long. 82°20′08″ W.); 179 meters; coral bottom; April 30, 1884 (3).

Albatross station 2319; Cuba; off Habana (lat. 23°10′37″ N., long. 82°20′06″ W.); 261 meters; gray coral; January 17, 1885 (1, U.S.N.M., 34594).

Corwin station 2; 1.6 miles off La Chorrera, near Habana, Cuba; 494 meters; May 24, 1867 [Pourtalès, 1868, 1869; P. H. Carpenter, 1879, 1883, 1888; Hartlaub, 1895, 1912; Minckert, 1905; A. H. Clark, 1907, 1909, 1918, 1923] (2+, U.S.N.M., 36135; M. C. Z., 267).

Blake station 101; Cuba; off Morro Light, Habana; 320–457 meters; December 1878 [Hartlaub, 1912; A. H. Clark, 1918].

University of Iowa's Bahama Expedition station 2; Cuba; about 2.5 miles off Habana; 201 meters [H. L. Clark, 1918] (1, U.S.N.M., E. 4340).

Albatross station 2152; Cuba; 2.5 miles northwest of Habana Light; 707 meters; bottom temperature 10.55° C.; April 30, 1884 (1).

University of Iowa's Bahama Expedition station 9; Cuba; off Habana; 366 meters [H. L. Clark, 1918] (fragments, M. C. Z., 736, 746).

University of Iowa's Bahama Expedition station 16; Cuba; off Habana; 366 meters [H. L. Clark, 1918].

Albatross stations 2319–2350; from Habana, Cuba, to Yucatán; 60–510 meters; January 17–20, 1885 [A. H. Clark, 1909, 1918; Gislén, 1934; H. L. Clark, 1941] (8, U.S.N.M., 25473 [type of *pulchra*], 34558, 34887, 34888).

Albatross station 2330; Cuba; off Habana (lat. 23°10′48″ N., long. 82°19′15″ W.); 221 meters; fine gray coral; January 17, 1885 [A. H. Clark, 1909] (1, U.S.N.M., 25474 [type of *gemmata*]).

Albatross station 2333; Cuba; off Habana (lat. 23°10′36″ N., long. 82°19′12″ W.); 309 meters; fine white coral; January 19, 1885 (1, U.S.N.M., 34554).

Albatross station 2320; Cuba; off Habana (lat. 23°10′39″ N., long. 82°18′48″ W.); 237 meters; fine coral; January 17, 1885 (2, U.S.N.M., 34556, 34557).

Albatross station 2334; Cuba; off Habana (lat. 23°10′42″ N., long. 82°18′24″ W.); 122 meters; white coral; January 19, 1885 (1).

Albatross station 2327; Cuba; off Habana (lat. 23°11′45″ N., long. 82°17′54″ W.); 333 meters; fine brown sand; January 17, 1885 (1, U.S.N.M., 34555).

Atlantis station 2999; Cuba; Bahia de Matanzas (lat. 23°10′ N., long. 81°29′ W.); 265–420 meters; March 17, 1938 [H. L. Clark, 1941].

Atlantis station 3000; Cuba; Bahia de Matanzas (lat. 23°10′ N., long. 81°29′ W.); 311–466 meters; March 21, 1938 [H. L. Clark, 1941].

Atlantis station 3466; Cuba; Bahia de Matanzas (lat. 23°09′ N., long. 81°27′30″ W.); 366 meters; May 9, 1939 [H. L. Clark, 1941].

Atlantis station 3478; Cuba; Bahia de Matanzas (lat. 23°09′ N., long. 81°27′30″ W.); 439 meters; May 11, 1939 [H. L. Clark, 1941].

Atlantis station 3482; Cuba; Bahia de Matanzas (lat. 23°09′ N., long. 81°27′30″ W.); 347 meters; May 11, 1939 [H. L. Clark, 1941].

Atlantis station 3465; Cuba; Bahia de Matanzas (lat. 23°09′ N., long. 81°27′ W.); 320 meters; May 9, 1939 [H. L. Clark, 1941].

Atlantis station 3467; Cuba; Bahia de Matanzas (lat. 23°11′30″ N., long. 81°26′ W.); 393 meters; May 9, 1939 [H. L. Clark, 1941].

Atlantis station 3326; Cuba; Bahia de Cochinos (lat. 22°09′ N., long. 81°09′ W.); 484 meters; April 4, 1939 [H. L. Clark, 1941].

Atlantis station 2987; Cuba; north of Puerto Sagua la Grande (lat. 23°22′ N., long. 79°53′ W.); 512–548 meters; March 13, 1938 [H. L. Clark, 1941].

Atlantis station 3438; Cuba; north of Caibarien (lat. 23°05′30″ N., long. 79°37′ W.); 484 meters; May 2, 1939 [H. L. Clark, 1941].

Atlantis station 3434; Cuba; north of Caibarien (lat. 23°10′ N., long. 79°35′ W.); 475 meters; May 1, 1939 [H. L. Clark, 1941].

Atlantis station 3430; Cuba; north of Caibarien (lat. 22°59′ N., long. 79°29′ W.); 430 meters; May 1, 1939 [H. L. Clark, 1941].

Atlantis station 3431; Cuba; north of Caibarien (lat. 23°02′ N., long. 79°29′ W.); 448 meters; May 1, 1939 [H. L. Clark, 1941].

Atlantis station 3432; Cuba; north of Caibarien (lat. 23°05′ N., long. 79°29′ W.); 457 meters; May 1, 1939 [H. L. Clark, 1941].

Atlantis station 3436; Cuba; north of Caibarien (lat. 23°05′ N., long. 79°28′ W.); 466 meters; May 2, 1939 [H. L. Clark, 1941].

Atlantis station 3435; Cuba; north of Caibarien (lat. 23°05′ N., long. 79°25′ W.); 466 meters; May 2, 1939 [H. L. Clark, 1941].

Atlantis station 2984; Cuba; north of Caibarien (lat. 23°16′ N., long. 79°10′ W.): 439–457 meters; March 12, 1938 [H. L. Clark, 1941].

Atlantis station 3425; Cuba; north of Caibarien (lat. 22°53′30″ N., long. 79°10′ W.); 457 meters; April 30, 1939 [H. L. Clark, 1941].

Atlantis station 2983; Cuba; north of Caibarien (lat. 23°11′ N., long. 79°08′ W.); 430–475 meters; March 12, 1938 [H. L. Clark, 1941].

Atlantis station 2983A; Cuba; north of Caibarien (lat. 23°11′ N., long. 79°08′ W.); 430 meters; March 12, 1938 [H. L. Clark, 1941].

Atlantis station 2982A; Cuba; north of Punta Alegre (lat. 22°48′ N., long. 78°50′ 30″ W.); 384 meters; March 11, 1938 [H. L. Clark, 1941].

Atlantis station 2982B; Cuba; north of Punta Alegre (lat. 22°47′ N., long. 47°48′ 30″ W.); 375–420 meters; March 11, 1938 [H. L. Clark, 1941].

Atlantis station 2980B; Cuba; north of Punta Alegre (lat. 22°48′ N., long. 78°48′ W.); 402–411 meters; March 10, 1938 [H. L. Clark, 1941].

Atlantis station 2982C; Cuba; north of Punta Alegre (lat. 22°46′ N., long. 78°45′ W.); 356–411 meters; March 11, 1938 [H. L. Clark, 1941].

Atlantis station 2980A; Cuba; north of Punta Alegre (lat. 22°48′ N., long. 78°41′ W.); 402–475 meters; March 10, 1938 [H. L. Clark, 1941].

Atlantis station 2980; Cuba; north of Punta Alegre (lat. 22°47′ N., long. 78°40′ W.); 457 meters; March 10, 1938 [H. L. Clark, 1941].

Atlantis station 3388; Cuba; off Cayo Coco (lat. 22°32′30″ N., ng. 78°09′ W.); 466 meters; April 26, 1939 [H. L. Clark, 1941].

Atlantis station 3372; Cuba; off Puerto Tanamo (lat. 20°45′ N., long. 75°17′ W.); 548 meters; April 20, 1939 [H. L. Clark, 1941].

Caroline station 43; southeast of Mona Island, between Haiti and Puerto Rico (lat. 18°03′45″ N., long. 67°48′10″ W.); 439–548 meters; February 11, 1933 (3, U.S.N.M., E.5255, E.5261, E.5262).

Off St. Thomas, Virgin Islands; 439 meters; Capt. A. Morrell, 1913 [A. H. Clark, 1929] (1, B.M.).

Caroline station 100; north of St. Thomas (lat. 18°40′15″ N., long. 64°50′15″ W.); 274 meters; March 4, 1933 (1, U.S.N.M., E.5235).

Caroline station 102; Virgin Islands (lat. 18°51′ N., long. 64°33′ W.); 256 meters; March 4, 1933 (1, U.S.N.M., E.5256).

One-and-one-half miles west of Frederiksted, St. Croix; about 475 meters; Dr. Th. Mortensen, January 18, 1906 (1, C. M.).

Blake station 157; off Montserrat; 219 meters; January 1879 [Hartlaub, 1912; A. H. Clark, 1918] (3+, M. C. Z., 272, 322).

Blake station 158; off Montserrat; 271 meters; stony bottom; January 1879 [Hartlaub, 1912; A. H. Clark, 1918].

Blake station 193; off Martinique (lat. 14°43′48″ N., long. 61°11′25″ W.); 309 meters; bottom temperature 10.56° C.; sand, shells, and dark mud; February 5, 1879 [Hartlaub, 1912; A. H. Clark, 1918].

Blake station 198; off Martinique (lat. 14°30′40″ N., long. 61°06′50″ W.); 250 meters; bottom temperature 11.39° C.; rocky bottom; February 6, 1879 [Hartlaub, 1912; A. H. Clark, 1918].

Investigator; Capt. A. Cole; apparently off Martinique [Hartlaub, 1912].

Blake station 219; off St. Lucia (lat. 13°49′50″ N., long. 61°03′50″ W.); 276 meters; bottom temperature 13.89° C.; gray sand; February 15, 1879 [Hartlaub, 1912; A. H. Clark, 1918] (1, M. C. Z., 271).

Albatross station 2752; between St. Lucia and St. Vincent (lat. 13°34′00″ N., long. 61°04′00″ W.); 514 meters; bottom temperature 8.89° C.; broken shells; December 4, 1887 (1, U.S.N.M., 21704).

Albatross station 2753; between St. Lucia and St. Vincent (lat. 13°34′00″ N., long. 61°03′00″ W.); 514 meters; bottom temperature 8.89° C.; black sand; December 4, 1887 [A. H. Clark, 1909, 1918, 1921, 1923; Gislén, 1934; H. L. Clark, 1941] (11, U.S. N.M., 25477 [type of *insculpta*], 21705, 21707, 21709, 36144; M. C. Z., 358).

Blake station 283; off Barbados (lat. 13°05′05″ N., long. 59°40′50″ W.); 431 meters; bottom temperature 9.44° C.; hard bottom; March 7, 1879 (1, M. C. Z., 50).

Blake station 269; off St. Vincent (lat. 13°07′55″ N., long. 61°05′36″ W.); 227 meters; bottom temperature 14.17° C.; coral; March 3, 1879 [Hartlaub, 1912; A. H. Clark, 1918].

Blake station 232; off St. Vincent (lat. 13°06′45″ N., long. 61°06′55″ W.); 159 meters; bottom temperature 16.67° C.; coral; February 21, 1879 [Hartlaub, 1912].

Blake station 272; off Barbados (lat. 13°04′12″ N., long. 59°36′45″ W.); 139 meters; bottom temperature 18.20° C.; coral and broken shells; March 5, 1879 [Hartlaub, 1912].

Blake station 241; off the Grenadines (lat. 12°28′22″ N., long. 61°32′18″ W.); 298 meters; bottom temperature 11.67° C.; sand and coral; February 24, 1879 [von Graff, 1883, 1884; P. H. Carpenter, 1888; Braun, 1888; A. H. Clark, 1907, 1918; Hartlaub, 1912].

Blake station 259; off Grenada (lat. 12°03′15″ N., long. 61°46′25″ W.); 291 meters; sand and ooze; bottom temperature 11.95° C.; February 28, 1879 [Hartlaub, 1912].

Blake station 249; off Grenada (lat. 11°48′15″ N., long. 61°48′45″ W.); 479 meters; bottom temperature 8.33° C.; coarse sand; February 27, 1879 [Hartlaub, 1912; A. H. Clark, 1918].

Caribbean Islands; 227–479 meters [P. H. Carpenter, 1888].

No locality; *Blake* [Hartlaub, 1912; A. H. Clark, 1918].

St. Helena; 2 miles S. 49° E. from Long Range Point; 280–360 meters; hard bottom; *Dana*, February 24, 1930 [Gislén, 1933].

St. Helena; 2 miles off Bay Point; 480 meters; *Dana*, February 24, 1930 [Gislén, 1933].

Geographical range.—From the Yucatán Bank, the Florida Keys, northern Cuba, and the southern Bahamas eastward and southward along the Antillean chain to Barbados and Grenada; also St. Helena.

Bathymetrical range.—From 139 to 707 meters.

Thermal range.—From 8.33° to 18.20° C.

History.—In a paper dated December 26, 1867, but distributed early in 1868, Count Louis François de Pourtalès described *Comatula brevipinna* as follows:

> Ten arms. Mouth and anus not seen in the only specimen examined. About 15 cirrhi, with the same number of long articulations. Seven or eight articulations to every syzygium. The two radials are visible, and have, as well as the axial radials and the two first brachials, a smooth tubercle in the middle. The same pieces are denticulated on the sides, the denticulations meeting those of the collateral radials and brachials, so as to close up the angle between them. A row of very small tubercles on the proximal border of the radials and radial axials. The articulations of the arms somewhat imbricate. First pinnule longest with about twelve joints. The other pinnules very short, having only five or six joints in the middle of the arm, but lengthening out again near the end of the arm, the last ones being tipped with a hook, like the cirrhi.
>
> In the only specimen obtained one of the arms is abortive and divided into three very short branches; to compensate, one of the arms of the next pair is divided into two from its origin.
>
> In 270 fathoms off Havana [*Corwin* station 2].

In another paper published in November 1869 Count Pourtalès said that *Antedon brevipinna* Pourt. [*Comatula brevipinna* Pourt.] was not obtained again since the first specimen was dredged in 1867.

In a paper published on December 14, 1878, Pourtalès described *Antedon granulifera* in the following terms:

> Twenty arms. Centrodorsal piece hemispherical and covered with cirrhi in the young, but becoming bare and flattened in the middle at a later period, showing more or less obsolete traces of the sockets. At the junction with the radials it has five knobs projecting into the interambulacral spaces. Cirrhi in two or more rows, with fifteen to eighteen joints, longer than broad, except the two or three first ones, which are very thick. Penultimate with a spine. First radials entirely concealed, very firmly connected with one another and with the rosette. Second radials [IBr_1] thin; axials very depressed, pentagonal. First brachials rather flattened and in close lateral contact. Three brachials between primary and secondary axials, one between secondary and tertiary. Syzygia rather irregular, nine, ten, or more joints apart. Sometimes there are syzygia in the first and second joints of the arms. The joints are somewhat saddle-shaped, with a deep notch for the insertion of the pinnules and a point on the proximal border fitting into a shallow notch of preceding joint. About the middle of the arm they are frequently, but not always, ornamented with bead-like tubercles, of which the middle one is largest. These tubercles are also found generally on the radials. First pinnule longest and very broad on first brachial, thence diminishing in length toward extremity. The joints of the pinnules are very broad. Mouth central. Spread 20 to 25 cm.
>
> [*Blake*] Station 45. Lat. 25°33′ N., Long. 84°21′ W. 101 fathoms.

In his memoir on the genus *Actinometra* published in 1879 Dr. P. H. Carpenter said that he was unable, on the basis of the published description, to assign *Comatula brevipinna* either to *Antedon* or to *Actinometra*.

In a preliminary report upon the comatulids of the *Blake* expedition published on October 1, 1881, Dr. Carpenter mentioned *Actinometra granulifera* as a species in which there is a considerable amount of anambulacral plating in the anal area; he said it is usually of the nature of an aggregation of tubercles rather than of a regular pavement of plates.

Prof. F. Jeffrey Bell in 1882 published a specific formula for *Antedon granulifera*. Early in 1883 this specific formula was emended by Dr. P. H. Carpenter, who published one also for *Antedon brevipinna*.

In 1883 Prof. Ludwig von Graff described the myzostomes found on a specimen on *Antedon pourtalesii* (*nomen nudum*) from *Blake* station 241, repeating this information in 1884.

In his report upon the comatulids of the *Challenger* expedition, published in 1888 Dr. Carpenter listed *Antedon brevipinna* among the species with 10 arms and also among the species with more than 10 arms and the IIBr series 2. He included it in a list of the 10-armed species in the *Blake* collection and remarked that, although normally IIBr 2 series are present, they are now and then absent in certain individuals. *Antedon brevipinna* was included in his key to the species of the *Spinifera* group, and he gave the range as Straits of Florida in 270 fathoms. This is *Corwin* station 2, at which only Pourtalès' single type specimen was dredged.

Carpenter included *Antedon granulifera* in his list of species with more than 10 arms with the IIBr series 4(3+4) and the IIIBr series 2(1+2). He remarked that there is a syzygy between the two elements of the IIIBr series in this species which escaped the notice of Pourtalès. He made *Antedon granulifera* the type of a special group, the *Granulifera* group including "Tridistichate species with plated ambulacra and the lower parts of the rays flattened laterally." He noted that neither the lateral flattening of the rays, nor the plated disk and ambulacral skeleton of this species, seem to have attracted the attention of Count Pourtalès when he examined it, though they have since turned out to be characters of primary systematic value, and called attention to the fact that Pourtalès had not noticed the syzygies between the two outer elements of the IIBr series and between the two elements of the IIIBr series; but he said that in neither case is the syzygy at all easy to recognize, and his omission to notice it is therefore not surprising. He said that in *granulifera* some of the IIBr series are usually absent, so that the arms spring directly from IBr axillaries, and noted that in arms arising from IBr axillaries the first syzygy is between brachials 3+4, while in other arms brachials 1+2 are united by syzygy, and brachials 3+4 may or may not be united by syzygy. He included *Antedon granulifera* in his key to the species of the *Granulifera* group in which it was paired with *Antedon distincta*, the difference given being that in *granulifera* the lower pinnules are "rather stout," whereas in *distincta* they are "comparatively slender." He said that some of the characters of *Antedon angusticalyx* and *A. inaequalis* appear in *A. granulifera* of the Caribbean Sea. Later, under *Antedon distincta*, he said that this species differs from *A. angusticalyx* and *A. inaequalis* in the long interval between the first and second syzygies in the arms, and also in the separation of the IIBr axillaries of adjacent rays by the pinnules on the preceding ossicles, which are attached more toward the dorsal surface than usual. This is less marked in *A. granulifera*, though it agrees with *A. distincta* in the long syzygial interval. On the other hand, he said, the joints of the genital pinnules of *A. distincta* are more uniformly expanded than in *A. granulifera*, which rather resembles *A. angusticalyx* and *A. inaequalis* in this respect. He noted that *A. granulifera* seems to be fairly abundant in the Caribbean Sea, but it exhibits a good deal of variation in its characters, which, he said, would be fully discussed in his report upon the *Blake* comatulids. He said that *Antedon* (*Koehlermetra*) *porrecta* and *A.* (*Thalassometra*) *multispina* may serve as a connecting link between *A.* (*Stiremetra*) *lusitanica* and the Caribbean *A. granulifera.* He gave the range of *granulifera* as Caribbean Islands, in 101–120 fathoms.

In the *Challenger* report there appears the name *Antedon pourtalèsi.* This is an emendation of the name *Antedon pourtalesii* used as a *nomen nudum* by von Graff in 1883 and 1884 and by Braun (following von Graff) in 1888. The names used by von Graff were given him by Carpenter. After supplying von Graff with the name *Antedon pourtalesii* Carpenter was informed by Prof. F. Jeffrey Bell, who was a classical scholar, that this and similar names should end in a single "i" instead of in two, and so in the *Challenger* report he used the spelling *pourtalèsi.* Carpenter included *Antedon pourtalèsi* in his list of species with more than 10 arms and the IIBr and IIIBr series of 2 elements. He said that it always has one and sometimes two axillaries beyond the IBr axillary, but the IIBr series are not always followed by IIIBr series. *Antedon pourtalèsi,* he said, is a fine species which he had dedicated to the memory of the late Count Pourtalès, adding that it is the host of *Myzostomum brevipes* von Graff (see pt. 2, p. 661). He included *pourtalèsi* in his key to the species of the *Spinifera* group of *Antedon,* in which it is paired with *brevipinna; pourtalèsi* Carpenter, MS. is said to have "The pinnules from the tenth to twentieth brachials have the third to fifth joints flattened and expanded laterally," while in *brevipinna* "The genital pinnules are comparatively slender with very slightly expanded joints." He listed *Antedon pourtalèsi* among the species found between 100 and 200, and also between 200 and 350 fathoms, and gave the range as the Caribbean Islands, in 124–262 fathoms.

Dr. Clemens Hartlaub in 1895 listed *Antedon brevipinna* as a species of the *Basicurva* group occurring in water up to 500 fathoms in depth, giving the range as Straits of Florida in 270 fathoms.

Dr. Wilhelm Minckert in 1905 gave an account of the distribution of the syzygies and regeneration in *Antedon brevipinna* based upon material in the *Blake* collection.

In my first revision of the old genus *Antedon* published in 1907 *brevipinna, granulifera,* and *pourtalèsi* were assigned to the new genus *Charitometra,* and in 1908 *Charitometra brevipinna* was compared with a new species, *Ch. smithi.* In another paper published in 1908 I described and figured a specimen with three pinnules on the same side of an arm on three consecutive brachials that I identified as *Charitometra imbricata* (=*Antedon granulifera* P. H. Carpenter 1888, not *Antedon granulifera* Pourtalès 1878=*Comatula brevipinna* Pourtalès 1869=*Antedon pourtalèsi* P. H. Carpenter 1888). I assumed that because Carpenter did not mention the granular ornamentation in his key to the species of the *Granulifera* group the specimen he regarded as representing *granulifera* was without it, and therefore not the *granulifera* of Pourtalès. But, as noted by Pourtalès himself, these tubercles are not always present in the specimens of the type series, and are therefore wholly without systematic significance. In a revision of the family Thalassometridae published on January 9, 1909, I established the new genus *Crinometra* and listed as the included species *Pachylometra brevipinna* (Pourtalès) and *Pachylometra imbricata* (A. H. Clark). In a paper published on June 19, 1909, I described briefly

Crinometra pulchra, *C. margaritacea*, *C. concinna*, *C. insculpta*, and *C. gemmata*. In a paper published on November 16, 1909, I wrote:

> Carpenter was loth to believe that a single species could be both "bi-" and "tri-distichate"; he observed the more or less frequent occurrence of both forms in the same individual, but he assigned the specimens to their systematic position on the strength of the character of the majority of their series. This is usually a safe enough guide, but in a few cases, such as this [*Comanthus parvicirra* ("*rotalaria*")], it is unreliable, and leads to erroneous conclusions. Minckert, on the other hand, had gone too far in the opposite direction; he credits a certain Caribbean species of Charitometrinae, *Crinometra brevipinna*, with the possession of IIBr series which may be all 4(3+4), all 2, or both in any combination, and he even makes it the type of a new "group", the "*Brevipinna* group". In reality he has confused a number of perfectly distinct species some of which have one arrangement, some the other, none, however, having both in equal proportions. *Crinometra* in this respect is exactly like *Pachylometra* [in the broad sense], its representative in the East Indies.

The extensive collections brought together by the United States Coast Survey steamers, particularly the *Blake*, together with a few from other sources, as for instance those that had been taken by Capt. A. Cole of the cable repair ships *Enterprise* and *Investigator*, had been sent by Alexander Agassiz to Dr. P. H. Carpenter for study and report. Some time after Dr. Carpenter's death on October 21, 1891, they were reassigned to Dr. Clemens Hartlaub. One of Hartlaub's students, Dr. Wilhelm Minckert, used the material in connection with a paper published in 1905, but the complete report was not published by Hartlaub until 1912.

Dr. Hartlaub was a friend and admirer of Dr. Carpenter, and his work on the *Blake* comatulids was modeled after the *Challenger* report. He told me that he considered it his duty to do this as the work had originally been undertaken by Carpenter, and also he wished to make his report conformable to the treatment in the *Challenger* report.

His account of this species is most excellent and exhaustive. He could not quite bring himself to adopt Minckert's concept of a *Brevipinna* group including species in which the IIBr series may be either 4(3+4) or 2, or both in any combination, but reverted to Carpenter's classification in which those species with plated ambulacra sharply flattened sides, and all or a majority of the IIBr series 4(3+4) were assigned to the *Granulifera* group and those, otherwise similar but with the IIBr series 2, were assigned to the *Spinifera* group.

He was thus led to distribute his specimens among three species, *angusticalyx* and *granulifera* in the *Granulifera* group, and *brevipinna* in the *Spinifera* group; but he discussed some specimens that seemed to him to be intermediate between *granulifera* and *brevipinna*, although he could not bring himself to admit the specific identity of the two forms. In identifying certain specimens with the Indo-Pacific *angusticalyx*, a species known to him only by Carpenter's description and figures, he was undoubtedly influenced by Carpenter's extensive comparisons between *angusticalyx* and *granulifera* in the *Challenger* report.

He divided *brevipinna* into twelve varieties. Of the twelve new names proposed by him seven (*gracilis*, *pulchra*, *elegans*, *tuberosa*, *diadema*, *laevis*, and *spinosa*) had previously been used in the genus *Antedon*. But since priority in nomenclautre is not concerned with names of a lower category than subspecies, his varietal names are used herein with the exception of *pulchra*, which conflicts with *Crinometra pulchra*, 1909, representing a different variety.

Hartlaub's determinations with the equivalents adopted herein are as follows:

Granulifera group:
  Antedon angusticalyx=*Crinometra brevipinna* var. *angusta*, nov.
  Antedon granulifera=*C. b.* var. *granulifera*, and *C. b.* var. *gemmata*
Spinifera group:
  Antedon brevipinna=*C. b.* var. *brevipinna*
  Antedon brevipinna var. *decora*=*C. b.* var. *insculpta*
  Antedon brevipinna var. *gracilis*=*C. b.* var. *gracilis*
  Antedon brevipinna var. *pulchra*=*C. b.* var. *pulchella*, nov.
  Antedon brevipinna var. *elegans*=*C. b.* var. *concinna*
  Antedon brevipinna var. *tuberosa*=*C. b.* var. *tuberosa*
  Antedon brevipinna var. *diadema*=*C. b.* var. *diadema*
  Antedon brevipinna var. *pourtalèsi*=*C. b.* var. *pourtalèsi*
  Antedon brevipinna var. *laevis*=*C. b.* var. *laevis*
  Antedon brevipinna var. *spinosa*=*C. b.* var. *spinosa*
  Antedon brevipinna var. *coronata*=*C. b.* var. *coronata*
  Antedon brevipinna var. *ornata*=*C. b.* var. *ornata*
  Antedon brevipinna var. *granulosa*=*C. b.* var. *granulosa*

In 1914 Prof. Frank Wigglesworth Clarke and Dr. W. C. Wheeler published an analysis of the inorganic components of the skeleton of this species (see pt. 2, p. 299, *Crinometra concinna*). This information was republished in 1917 and 1922.

In his report upon the Crinoidea collected by the Bahama Expedition from the University of Iowa in 1893 Dr. Hubert Lyman Clark in April, 1918, recorded and gave notes on *Crinometra gracilis* from station 2, and *C. ornata* from stations 9 and 16.

In my report upon the unstalked crinoids of the *Siboga* expedition published in 1918 I listed all the forms referable to *Crinometra* under their original names, and said that the species referred to by Hartlaub as *Antedon angusticalyx* P. H. Carpenter, *A. granulifera* Pourtalès, and *A. pourtalèsi* P. H. Carpenter, as well as *A. brevipinna* (Pourtalès) belong in *Crinometra*. In my report upon the Crinoidea of the Danish *Ingolf* Expedition I listed, as members of the genus *Crinometra*, *C. brevipinna*, *C. insculpta*, *C. granulifera*, and *C. gemmata* and gave their ranges. In 1929 I recorded, without comment, a specimen of *Crinometra brevipinna* from off St. Thomas, V. I., in 240 fathoms that had been presented to the British Museum by Capt. A. Morrell.

In 1933 Prof. Torsten Gislén described and figured an interesting new form from St. Helena which he called *Crinometra transversa*, and in 1934 he discussed the brachial structure of *Crinometra concinna*, *C. gemmata*, *C. imbricata*, *C. insculpta*, *C. margaritacea*, *C. pulchra*, and *C. transversa*.

Dr. Hubert Lyman Clark in 1941 recorded *Crinometra granulifera*, *C. insculpta*, and *C. pulchra* from various localities about Cuba where they had been dredged by the oceanographic ship *Atlantis*, working under the joint auspices of the University of Havana and Harvard University.

Genus CHARITOMETRA A. H. Clark

Antedon (part) von Graff, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, p. 17, and following authors.

Charitometra A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 360 (diagnosis; genotype *Antedon incisa* P. H. Carpenter, 1888); Bull. Mus. Comp. Zool., vol. 51, No. 8 1908, p. 245 (same); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 136 (referred to the Thalassometridae);

Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211 (referred to the Thalassometridae), p. 212 (occurs in the West Indies, Japan, and the Hawaiian Islands), p. 275 (proximal ornamentation); vol. 35, 1908, p. 120 (arm structure), fig. 19, p. 120; Amer. Nat., vol. 42, No. 500, 1908, p. 542 (excluding the *aculeata*, *hepburniana*, *basicurva*, and *tuberosa* groups, a characteristic oceanic genus); No. 503, p. 723 (range; habitat); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (oceanic, excluding the *aculeata*, *hepburniana*, *basicurva*, and *tuberosa* groups); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 1 (revision), p. 20 (list of included species as restricted).—HARTLAUB, Mem. Mus. Comp. Zool., vol. 27, No. 4, 1912, p. 286 (constitution; discussion).—A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 9 (absent from Australia), p. 10 (absent from Japan), p. 11 (absent from the west coast of the Malay Peninsula, the Andamans, and farther west), p. 25 (range), p. 60 (in key), p. 226 (original reference; type); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 172 (in key; range), p. 191 (key to the included species).—GISLÉN, Nova Acta Reg. Soc. Sci. Upsaliensis, ser. 4, vol. 5, No. 6, 1922, p. 7 (relation to *Diodontometra*); Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 9; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18; Kungl. Svensk. Vet.-Akad. Handl., ser. 3, vol. 17, No. 2, Oct. 3, 1938, p. 20.

Diagnosis.—The genital pinnules have the third and fourth or fourth and fifth segments greatly expanded, the abruptly narrower portion of the pinnules beyond being shorter than the expanded portion; the basal portion of the animal is compressed, the two sides in lateral view making an angle of about 45° with each other; the IBr series and lower brachials are in close lateral contact and are sharply and broadly flattened against their neighbors; the 10 arms are 90–100 mm. long.

Geographical range.—From Fiji to the Kermadec Islands.

Bathymetrical range.—One definite record, 1,152 meters.

Thermal range.—One record, 4.17° C.

History.—The genus *Charitometra* was established in 1907 to include all the species of the old genus *Antedon* now regarded as falling within the family Charitometridae except for two that were assigned to the genus *Poecilometra*. It also included two species, *compressa* and *orion*, which in 1909 were removed to the new genus *Parametra* and transferred to the family Thalassometridae.

In 1909 *Charitometra* was restricted to its present significance through the removal of most of the included species to the new genera *Glyptometra*, *Strotometra*, *Pachylometra*, *Chlorometra*, and *Crinometra*.

KEY TO THE SPECIES IN THE GENUS CHARITOMETRA

a^1. Brachials from the fourth onward with prominently thickened, everted, and beaded or tuberculated distal edges, this feature gradually dying away after the brachials become triangular; arms about 100 mm. long (Kermadec Islands; 1,152 meters)............**basicurva** (p. 348)

a^2. Brachials with unmodified distal ends, the arms appearing quite smooth (Kermadec Islands and Fiji; 1,152 meters)..**incisa** (p. 352)

CHARITOMETRA BASICURVA (P. H. Carpenter)

[See vol. 1, pt. 1, figs. 279, p. 260, 495, p. 367; pt. 2, pl. 3, figs. 990, 991, pl. 26, fig. 1160, pl. 27, fig. 1167.]

Antedon basicurva VON GRAFF, *Challenger* Reports, Zoology, vol. 10, pt. 27, 1884, pp. 17, 70, 73 (myzostomes; *Challenger* station 170; *nomen nudum*).—P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 11, pt. 32, 1884, p. 84; pl. 54, fig. 9; pl. 55, fig. 7.—VON GRAFF, *Challenger* Reports, Narrative, vol. 1, pt. 1, 1885, p. 316 (myzostomes).—P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 120 (description; *Challenger* stations 170A, ?175), pl. 2, figs. 2, *a–d*, pl. 21, fig. 3, pl. 22, figs. 3, 4, text fig. 2, A, B, p. 100, duplicated on p. 122.—BRAUN, Centralbl. Bakteriol. und Parasitenkunde, vol. 3, 1888, p. 210 (myzostomes; after von Graff).—P. H. CARPENTER, Journ. Linn. Soc. (Zool.), vol. 24, 1891, p. 67 (compared with (*A.* [*Stiremetra*] *lusitan-*

ica).—Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (systematic and bathymetrical relationships.)—Bather, *in* Lankester, A treatise on zoology, pt. 3, Echinoderma, 1900, fig. ix, 2, p. 102.—Hutton, Index faunae Novae Zealandiae, 1904, p. 290 (listed).—Minckert, Arch. Naturg., Jahrg. 71, 1905, vol. 1, p. 169 (syzygies).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (identify).

Charitometra basicurva A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed); Geogr. Journ. vol. 32, No. 6, 1908, p. 603 (type of non-oceanic group); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 20 (listed); Crinoids of the Indian Ocean, 1912, p. 33 (identity), p. 226 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 49 (published references to specimens in the B. M.; *Challenger* station 170A); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 191 (in key; range).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 9 (notes).

Diagnostic features.—The brachials from the fourth onward have prominently thickened and everted, and beaded or tuberculated, distal edges, this feature gradually dying away after the brachials become triangular; the 10 arms are about 100 mm. long.

Description.—The centrodorsal is hemispherical with a very rough dorsal pole and small interradial processes. According to the figures given by Carpenter the cirrus sockets are evenly distributed, in 10 irregular columns in the young and 15 in the fully grown.

The cirri are about XX, 18–20; the segments are very stout, most of them longer than broad. The distal ends of the earlier segments overlap slightly, those of the later ones more strongly, especially on the dorsal side so as to produce a blunt spine on the distal edge, which is rather sharp on the penultimate.

The radials and sometimes portions of the IBr_1 are concealed. The IBr_1 are short and bandlike, in close lateral contact; they have raised edges which are often somewhat crenulate, and there is usually a slight tubercle on the distal border corresponding to one on the axillary. The IBr_2 (axillaries) are short and pentagonal with a wide, open angle and more or less crenulated edges. The dorsal surface is very convex with the margin more or less flattened, and with sharply flattened wall-like sides.

The 10 arms are about 100 mm. long and are composed of about 120 brachials. The first brachials are short, nearly oblong, and are closely united interiorly. The second brachials are more wedge-shaped. Both rise toward their apposed edges to form a median elevation (synarthrial tubercle) like that between the elements of the IBr series. The following brachials are short until about the twelfth, after which they are longer and more triangular, gradually becoming wedge-shaped. The terminal brachials are elongated and slightly compressed laterally. The first four brachials are wall-sided with flattened margins like the axillaries. In the proximal portion of the arms the distal edge of each brachial stands up as a sharp crenulated ridge from which the surface slopes backward. Farther out on the arms as the brachials become longer this sudden rise disappears, and the brachials overlap in the ordinary way.

Syzygies occur between brachials 3+4 and again from between brachials 10+11 to between brachials 17+18; the distal intersyzygial interval is from 2 to 17 (usually 4 to 8) muscular articulations.

P_1 is short with about 22 segments of which the 6 proximal are trihedral and much flattened on the outer side with a marked dorsal keel which is lost in the smaller terminal segments. P_a is similar but rather smaller. P_2 has fewer segments, but the third and fourth are relatively broader, and in the succeeding pinnules very much broader with their outer faces greatly expanded toward the ventral side. This condition is most marked at about P_6 and then gradually decreases, being traceable to P_{12} or P_{15}. After this is lost the pinnules gradually diminish in stoutness, but do not increase much in length.

The disk is 7 mm. in diameter and is much incised and completely plated, as are also the arms both along the ambulacra and at their sides. The gonads are protected by stout anambulacral plates. The ambulacra of the distal pinnules have well defined side plates alternating with, but often partly concealing, the sacculi, which are abundant and very large, especially on the genital pinnules.

The color in alcohol is dark gray-brown, of the young individuals yellowish brown.

Notes.—In the *Challenger* report on the stalked crinoids Carpenter noted that in this species the irregular double row of transversely oblong plates bordering the ambulacral grooves on the disk is barely distinguishable from the anambulacral plates, and the whole set encroaches very much upon the peristome so that in a dry state it is scarcely visible.

He said that the first pair of pinnules in this species are considerably different from their successors. P_1 is rather larger than P_a, but the general characters are identical. All the segments are quite short, but the first five or six are broad, carinate, and trihedral, with their outer sides flattened somewhat as in *Aglaometra valida* and allied species. Traces of this flattening are apparent on P_2, but P_b and the following pinnules have the third and fourth segments very broad and expanded, though the fifth is smaller again and its successors very much so. These lower segments, which are so broad and almost flat on their outer side, afford support and protection to the gonads which are situated on their inner faces. The ventral surface of the gonads is covered by a pavement of anambulacral plates often with large sacculi imbedded in them here and there. But there are no side and covering plates as in the distal pinnules. Carpenter said that the expansion of the third and fourth pinnule segments is best developed about the tenth or twelfth brachials, after which it gradually becomes less and less marked and the later segments more and more elongated. But the third and fourth segments are often distinctly broader and flatter than their successors as far out as the thirtieth brachial, after which they assume a more elongate form.

Carpenter said that in one quite young specimen about one-third the size of a fully grown individual there is comparatively little trace of the expansion of the third and fourth segments even on the lower pinnules. The arms, too, are much smoother than in the adult, the edges of the lower brachials being but slightly raised and showing no trace of the crenulation which is so marked in the more mature individuals. The radials are just visible as narrow curved bands immediately above the centrodorsal which are not smooth and continuous as usual but broken here and there by pits. In a slightly older individual they are represented only by a row of irregular processes between the centrodorsal and the IBr$_1$, while in the mature form they are altogether invisible, though traces of the processes appear after the removal of the IBr$_1$.

In this species Carpenter noted that the upper surface of the centrodorsal is so much larger than the base of the radial pentagon that the IBr$_1$ partly rest upon it and so completely conceal the radials as in some forms of *Antedon bifida*. The cirrus sockets are peculiar in having a very large articular facet in the center from which radiating processes extend all around to the margin of the socket. The dorsal surface of the radial pentagon is marked by a well defined basal star the angles of which do not, however, appear externally. The central funnel of the calyx is smaller than in *Stiremetra breviradia*, as the ventral ends of the muscle plates are less everted than in that type. Carpenter said there is a further resemblance between this species and the mature *Stiremetra breviradia* in the presence of transverse ridges and furrows at the lower ends of the muscular fossae; but he said he had found two radials without them in a calyx of *basicurva*.

At the British Museum I examined five specimens of this species from *Challenger* station 170A and remarked that it had been well figured by Carpenter. After examining these same specimens Gislén noted that the cirri are stout with a longitudinal carination and the opposing spine in the form of a transverse crest.

Locality.—Challenger station 170A; near the Kermadec Islands, north of New Zealand (lat. 29°45′ S., long. 178°11′ W.); 1,152 meters; bottom temperature 4.17° C.; volcanic mud; July 14, 1874 [von Graff, 1884, 1885; P. H. Carpenter, 1884, 1888, 1891; Braun, 1888; Hartlaub, 1895; Bather, 1900; Hutton, 1904; Minckert, 1905; Hamann, 1907; A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1918; Gislén, 1928] (5, B. M.).

Doubtful locality.—Challenger station 175; near Kandavu, Fiji (lat. 19°02′ S., long. 177°10′ E.); 2,468 meters; bottom temperature 3.33° C.; globigerina ooze; August 12, 1874 [P. H. Carpenter, 1888]. Carpenter said that only two comatulids are recorded in the station book as having been found at this locality, and as the depth is considerable he had little doubt that they were the two small species *Stiremetra breviradia* and *S. acutiradia*. The arms of the latter were all loose and Carpenter said it is quite possible that the few arm fragments of *Charitometra basicurva* may have been among them; but no calyx of this species was obtained.

History.—Antedon basicurva was first mentioned by Prof. Ludwig von Graff in his account of the myzostomes of the *Challenger* expedition published in 1884. The name was a *nomen nudum*. He gave the locality as *Challenger* station 170. In his report on the stalked crinoids of the *Challenger* expedition published in the same year Dr. P. H. Carpenter gave a short note on the plating of the disk in *Antedon basicurva*, for which he gave a specific formula, and figured a portion of a distal pinnule showing the side and covering plates as well as the disk. In the report on the comatulids of the *Challenger* expedition published in 1888 Carpenter described *Antedon basicurva* in detail and figured it. In the same year Braun listed it as the host of certain myzostomes, taking his information from von Graff.

In 1891 Carpenter compared *Antedon basicurva* with *Antedon* (*Stiremetra*) *lusitanica*, and in 1895 Dr. Clemens Hartlaub discussed its systematic and bathymetrical relationships. Dr. F. A. Bather in 1900 published a figure of a portion of a distal pinnule with the side and covering plates redrawn from the figure published by Carpenter in 1884. Captain Hutton listed *Antedon basicurva* as a New Zealand species in 1904, Minckert discussed the syzygies in 1905, and Hamann listed it in 1907.

In my first revision of the old genus *Antedon* published in 1907 *basicurva* was transferred to the new genus *Charitometra*. *Charitometra basicurva* was mentioned as the type of an oceanic group in 1908, and was listed in 1909. In my memoir on the crinoids of the Indian Ocean published in 1912 *Charitometra basicurva* was listed and the synonymy and range were given. In 1913 I noted that I had examined five of Carpenter's original specimens from *Challenger* station 170A at the British Museum and that it had been well figured by Carpenter. In my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 *basicurva* was included in the key to the species of *Charitometra* and the synonymy and range given. Prof Torsten Gislén in 1928 published notes on the specimens which he had examined in the British Museum.

CHARITOMETRA INCISA (P. H. Carpenter)

[See vol. 1, pt. 1, figs. 278, p. 260, 494, p. 367; pt. 2, pl. 3, figs. 992, 993.]

Antedon incisa VON GRAFF, *Challenger* Report, Zoology, vol. 10, pt. 27, 1884, pp. 18, 31, 70 (myzostomes; *Challenger* stations 170, 174; *nomen nudum*); Narrative, vol. 1, pt. 1, 1885, p. 316 (myzostomes); Zoology, vol. 20, pt. 61, 1887, p. 2 (myzostomes; *Challenger* station 170).—P. H. CARPENTER, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 124 (description; *Challenger* stations 170A, 174, B, C, or D), pl. 2, figs. 1, *a-d;* pl. 21, (figs. 1, 2).—BRAUN, Centralbl. Bakteriol. und Parasitenkunde, vol. 3, 1888, p. 185 (myzostomes; after von Graff).—HARTLAUB, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 131 (systematic and bathymetrical relationships).—LANG, A text book of comparative anatomy, vol. 2, 1896, p. 312, fig. 258.—HUTTON, Index faunae Novae Zealandiae, 1904, p. 290 (listed).—A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 140 (comparison with *A.* [*Strotometra*] *hepburniana*).—HAMANN, Bronn's Klassen und Ordungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. CLARK, Crinoids of the Indian Ocean, 1912, p. 33 (identity).

Charitometra incisa A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 20 (listed); Crinoids of the Indian Ocean, 1912, p. 33 (identity), p. 227 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 49 (published reference to specimens in the B. M.; *Challenger* stations 170A, 174); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 191 (in key; range).—GISLÉN, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 9, No. 43 (notes).

Diagnostic features.—The lower brachials are smooth with unmodified distal ends; the 10 (rarely 11) arms are about 90 mm. long. This is possibly only a smooth-armed variety of *Ch. basicurva.*

Description.—The centrodorsal is hemispherical with a rough dorsal pole and small interradial processes. According to the figures the cirrus sockets are arranged in a single irregular marginal row.

The cirri are about XV, 15–18; the segments are rather stout, most of them longer than broad, the longest according to the figure not quite twice as long as broad. In the younger cirri the later segments overlap very slightly on the dorsal side so as to produce faint spines; this is lost in the older cirri except in the penultimate, which bears a strong opposing spine.

The radials are short and bandlike with curved borders and are in apposition above the interradial processes of the centrodorsal. The IBr_1 are somewhat longer and are in close lateral contact and rather convex in the center where they are but little incised for their junction with the IBr_2 (axillary) which is also sharply convex, short, and pentagonal, with very open angles. The axillaries and first four or five brachials have the marginal portions of their dorsal surface flattened vertically, with sharp edges and wall-like sides.

The 10 arms are about 90 mm. long. The first brachials are almost oblong and very convex in the center. The second are shorter and more wedge-shaped. The brachials following are smooth and rather short until about the tenth, then longer and obliquely quadrate, becoming blunter and more elongated toward the end of the arm, but without any overlap.

The first syzygy is between brachials 3+4, the next frequently between brachials 11+12, though sometimes not until between brachials 19+20, and the distal intersyzygial interval is from 2 to 10, generally from 5 to 7, muscular articulations.

P_1 is longish with about 30 short segments, of which the proximal are rather flattened on the outer side with a sharp dorsal keel. P_a is similar but shorter. P_2 is longer with fewer but larger segments of which the fourth and fifth are broad and expanded toward the ventral side. This expansion increases in the following pinnules, which have the third and fourth segments largest. This is most marked about P_{12}, but is traceable to the thirtieth brachial. The remaining pinnules diminish in stoutness without increasing much in length.

The disk is 7 mm. in diameter, much incised and pretty completely plated as are also the brachial ambulacra. The gonads are protected by stout anambulacral plates. The ambulacra of the distal pinnules have well marked side plates, which are generally notched for the sacculi. The sacculi are large and abundant, especially on the distal pinnules.

The color in alcohol is brownish white or light yellowish brown.

Notes.—Supplementing the foregoing description Carpenter wrote that this species is readily distinguished from *Ch. basicurva* by the smoothness of the arms and the appearance of the radials externally. Another point of difference is that the wall-sidedness of the arm bases extends out to the fifth or even the sixth brachial which is not the case in *Ch. basicurva.* On the other hand, the basal segments of P_1 and P_a in the type from station 170A are less flattened and not so distinctly trihedral as is *Ch. basicurva* so that the proximal pinnules are more like their successors than is the case in that species. But Carpenter noted that in the two individuals from station 174 (B, C, or D) where *Ch. basicurva* did not occur the lower segments of P_1 show a distinct tendency toward the trihedral form characteristic of that type.

Carpenter said that the radials are completely visible in all the specimens of *incisa,* though they are shortest in those which are most mature, barely reaching half the length of the IBr$_1$, to which they are nearly equal in some of the younger individuals. He remarked that this species has a relatively smaller centrodorsal than *basicurva* so that the radial pentagon covers it completely, and no part of it is exposed when the IBr$_1$ are removed. The dorsal aspect of the radial pentagon is much the same in the two types, except for the portion of the radial which appears externally in *Ch. incisa.* But the lower ends of the muscular fossae in the latter are almost entirely without the ridge and furrow markings which are generally present in *Ch. basicurva.* The articular facet of the cirrus sockets is relatively smaller in *incisa* than in *basicurva,* and the radiating processes around the edge of the socket are less distinct.

After examining Carpenter's specimens in the British Museum Gislén noted that there are no dorsal spines on the cirri and that the opposing spine is a transverse, not bisected, ridge. On one specimen he found a IIBr 4(3+4) series following which on one arm the first syzygy was between brachials 1+2.

Localities.—*Challenger* station 170A; near the Kermadec Islands, north of New Zealand (lat. 29°45′ S., long. 178°11′ W.); 1,152 meters; bottom temperature 4.17° C.: volcanic mud; July 14, 1874 [von Graff, 1884, 1885, 1887; P. H. Carpenter, 1888;

Braun, 1888; Hartlaub, 1895; Lang, 1896; Hutton, 1904; A. H. Clark, 1907, 1909, 1912, 1913, 1918; Hamann, 1907; Gislén, 1928] (1, M. C. Z., 269).

Challenger station 174 (B, C, or D); near Kandavu, Fiji (lat. [about] 19°06′ S., long. [about] 178°18′ E.); 466, 1,115, or 384 meters; bottom temperature (at 1,115 meters) 3.88° C.; coral mud; August 3, 1874 [von Graff, 1884, 1885; P. H. Carpenter, 1888; Braun, 1888; Hartlaub, 1895; A. H. Clark, 1907, 1909, 1912, 1913, 1918; Hamann, 1907; Gislén, 1928] (3, B. M., labeled as from both stations).

Geographical range.—From the Kermadec Islands to Fiji.

Bathymetrical range.—One definite record, 1,152 meters.

Thermal range.—One definite record, 4.17° C.

History.—*Antedon incisa* was first mentioned as a *nomen nudum* by Prof. Ludwig von Graff in his account of the myzostomes of the *Challenger* Expedition published in 1884; he gave as the localities stations 170 and 174. He mentioned it again in 1885 and also in 1887, when he gave the locality as station 170.

It was described in detail and figured by Dr. P. Herbert Carpenter in his report on the comatulids of the *Challenger* Expedition published in 1888, and in the same year it was listed as a host of myzostomes by Braun, quoting from von Graff. Dr. Clemens Hartlaub in 1895 discussed its systematic and bathymetrical relationships, and in 1896 Prof. Arnold Lang reproduced Carpenter's figure (plate 21, figure 1) redrawn so as to show all the arms and pinnules complete. In 1904 Capt. F. W. Hutton listed *Antedon incisa* as a New Zealand species, and in 1907 it was listed by Hamann.

In my first revision of the old genus *Antedon* published in 1907 *incisa* was made the type of the new genus *Charitometra*. In my revision of the families Thalassometridae and Himerometridae published in 1909 I listed *Charitometra incisa*, and in my memoir on the crinoids of the Indian Ocean published in 1912 it was again listed and the synonymy and range were given. In my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1908 *incisa* was included in the key to the species of *Charitometra* and the synonymy and range were given. In 1928 Prof. Torsten Gislén published notes on the specimens in the British Museum.

Genus POECILOMETRA A. H. Clark

Antedon (part) P. H. CARPENTER, Pop. Sci. Rev., vol. 4, No. 15, 1880, pl. 6, fig. 10, and following authors.

Poecilometra A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (diagnosis; genotype *Antedon acoela* P. H. Carpenter, 1888); Bull. Mus. Comp. Zool., vol. 51, No. 8, 1908, p. 245 (same); Proc. Biol. Soc. Washington, vol. 21, 1908, p. 136 (referred to the Thalassometridae); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 211 (referred to the Thalassometridae), p. 212 (occurs in Japan); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 18 (listed, with included species); Crinoids of the Indian Ocean, 1912, p. 9 (absent from Australia), p. 11 (absent from the west coast of the Malay Peninsula, from the Andamans, and from farther west), p. 25 (range), p. 60 (in key), p. 225 (original reference; type); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 172 (in key; range), p. 190 (key to the included species).—GISLÉN, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 9; Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.

Diagnosis.—The genital pinnules have the third to seventh and fifth to ninth segments greatly expanded, the segments beyond the expanded portion of the pinnules being very small; the ossicles of the division series and lower brachials are relatively narrow and well separated from each other, the gaps between them being more or less completely bridged over by the lateral extension of the dorsolateral edge into a thin flangelike border which persists as far as the fourth or fifth brachial; and the 10 arms are 100–110 mm. long.

Geographical range.—From Celebes to southwestern Japan.

Bathymetrical range.—From 660 to 1,327 meters.

Thermal range.—From 5.44° to 5.95° C.

History.—The genus *Poecilometra* was established in 1907 to include Carpenter's *Antedon acoela*, the type species, and another species that had been described a few months earlier from southern Japan. The genus has since been maintained in its original significance.

KEY TO THE SPECIES IN THE GENUS POECILOMETRA

a^1. Centrodorsal large and broad, in large specimens about 5 mm. in diameter at the base; the profile of the IBr series and arm bases makes only a very slight angle with the dorsoventral axis; the IBr series are usually, though not always, somewhat constricted so that the arm bases broaden rather suddenly above them; the cirri are XXV–XXX, 15–18; the arms are about 100 mm. long (northern Celebes to Mindanao; 914–1,327 meters)........................**acoela** (p. 355)

a^2. Centrodorsal smaller, 4 mm. in diameter at the base; the profile of the IBr series and arm bases makes an angle of about 60°, or about 30° with the dorsoventral axis; there is no constriction of the IBr series; the cirri are about XX, 20; the arms are 110 mm. long (southwestern Japan; 660 meters)........................**scalaris** (p. 359)

POECILOMETRA ACOELA (P. H. Carpenter)

[See vol. 1, pt. 1, figs. 7, 8, p. 63, 277, p. 260, 493, p. 367; pt. 2, pl. 3, figs. 988, 989, pl. 14, figs. 1057, 1058, 1061, pl. 26, fig. 1161, pl. 27, fig. 1169.]

Antedon sp. P. H. Carpenter, Pop. Sci. Rev., vol. 4, No. 15, 1880, pl. 6, fig. 10 (side and covering plates of a pinnule).

Antedon acoela P. H. Carpenter, *Challenger* Reports, Zoology, vol. 11, part 32, 1884, pp. 57, 83, 84, 93, 109, 110, 113, 128, pl. 54, figs. 1–4; pl. 55, fig. 5; Quart. Journ. Micr. Sci., vol. 27, 1887, p. 391 (sacculi), pl. 30, fig. 3 (side and covering plates); *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 132 (description; *Challenger* station 214), pl. 2, figs. 3, *a-d*; pl. 16, figs. 1–5.—Hartlaub, Nova Acta Acad. German., vol. 58, No. 1, 1891, p. 113 (in Göttingen Mus.).—Shipley and MacBride, Zoology, 1901, p. 269, fig.—Minckert, Arch. Naturg., Jahrg. 71, 1905, vol. 1, Heft 1, p. 190 (syzygies and regeneration).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed), pl. 12, fig. 1 (from Carpenter).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (identity).

Poecilometra acoela A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 362 (listed); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 18 (listed); Crinoids of the Indian Ocean, 1912, p. 33 (identity), p. 225 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 50 (published references to specimens in the B. M.; *Challenger* station 214; comparison with *P. scalaris*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 190 (in key; range; references; notes; stations 122, 124), p. 273 (listed).—Gislén, Zool. Bidrag Uppsala, vol. 9, 1924, p. 280.

Diagnostic features.—The lateral profiles of the IBr series are almost parallel, those of the arm bases slightly diverging; the IBr series are constricted so that there is a sudden broadening at the first brachial; in small individuals in which the constriction of the IBr series has not developed the profiles of the proximal portion of the animal diverges at an angle of about 45°; the centrodorsal is large and broad, up to 5 mm. across at the base; the cirri are XXV–XXX, 15–18; and the arms are up to 100 mm. long.

Description.—The centrodorsal is subconical or hemispherical. The cirrus sockets are evenly distributed and are arranged roughly in 2 rows and from 10 to 15 columns.

The cirri are XXV–XXX, 15–18. Nearly all the segments are longer than broad, according to the figure mostly about twice as long as broad. There is but little trace of an opposing spine, and the terminal claw is curved and sharp.

The radials are visible only in young specimens. The IBr_1 are somewhat flattened with a convex proximal and concave distal border. The IBr_2 (axillaries) are more convex, broadly pentagonal or almost rhombic, with a wide distal angle and sometimes projecting deeply posteriorly into the IBr_1. The dorsal surface of the elements of the IBr series, the first two brachials, and the hypozygal of the first syzygial pair project beyond their faces and sides, especially the latter which fall away rapidly from the dorsal towards the ventral border.

The 10 arms are probably 100 mm. long and consist of about 100 brachials. The first brachials are nearly oblong with rounded outer edges. The second are convex and irregularly pentagonal. Those following are smooth and triangular, as long as or longer than broad.

Syzygies occur between brachials 3+4, again at about brachials 12+13 or 13+14, and distally at intervals of from 3 to 6 (usually 4 or 5) muscular articulations.

P_1 and P_a are composed of about 30 short segments the lowest of which is a good deal wider than the others. In the pinnules from the fourth to the twenty-fifth brachial about 3 to 5 of the segments are greatly expanded laterally to enclose the gonads, and the first segment is much wider than its successors, especially in the lower pinnules. The later pinnules have longer and more trihedral segments the lowest of which are flatter.

The disk is 5 mm. in diameter, rather incised, and completely covered with irregular plates bearing short and blunt rodlike spines. The brachial ambulacra and the interarticular spaces are well plated, and the expanded parts of the genital pinnules are completely enclosed in an arched pavement of flat plates very regularly arranged and devoid of ambulacra. The ambulacra of the later pinnules have very well defined side plates, sometimes covering the sacculi and sometimes notched for them. These are very abundant except on the non-tentaculiferous genital pinnules.

The color of young specimens in alcohol is straw color; the older ones are a dense brownish gray, becoming a dark gray in the most mature.

Notes.—Carpenter said that in its general characters this species has many points of resemblance with *Charitometra basicurva*, *Ch. incisa*, and *Glyptometra tuberosa*; but the sides of the elements of the IBr series are not in close apposition and flattened laterally against each other as in those types, for they fall away very rapidly from the dorsal toward the ventral surface so that there is a considerable space between every two postradial series, especially at the level of the articulation. This is smaller on the surface than it is deeper down, for the lateral edges of the ossicle are produced outward, like the projecting eaves of a roof. This condition is extremely marked in the case of the IBr_1, which has the proximal edge similarly produced so as to overlap the minute portion of the radials which appears externally.

Carpenter said that the relative shapes of the elements of the IBr series vary extremely. In some individuals the IBr_1 are approximately oblong and show hardly any indication of an incised distal edge, while the axillaries are broadly pentagonal. On the other hand, the axillaries sometimes project far back into the IBr_1 which then have a deeply incised distal edge, while the proximal edge is also much curved.

In young specimens a considerable portion of the radials is visible, but the projection of the edge of the next following ossicle is almost as marked as in the mature individual. In the youngest specimen with the arms about 40 mm. long the external surface of the radials is rather less wide than that of the IBr_1 and a trifle more than half its length. It does not, however, increase in size with the corresponding parts of the IBr series, but remains undeveloped and is sometimes marked by small tubercular elevations like those on the centrodorsal from which it is with difficulty distinguishable. These are situated in the gap between the ventral edge of the centrodorsal and the proximal edges of the IBr_1 which project backward so as to overlap them.

Carpenter said that the most striking feature of *acoela*, and the one which allies it most closely to the *Basicurva* group, is the great size both of the segments and of the protecting plates of the genital pinnules. Even the pinnules of the second pair (P_2 and P_b) are enlarged for the reception of the gonads, three of their middle segments being expanded; and a little farther from the disk the fifth and the four or five following segments are flattened and produced laterally, the proximal segment being often much enlarged at the same time. This expansion is not almost entirely limited to the outer side only as in *Charitometra incisa*, but it is equal on both sides of the mediodorsal line, and the ventral portion of these expanded segments is covered by an arched pavement of strong plates, few in number but of large size and often very regularly arranged. These protecting plates are much larger and better developed than in either *Charitometra incisa* or *Glyptometra tuberosa*, and they often alternate more or less regularly on opposite sides of the medioventral line of the pinnule, where there is an opening in one of them for the exit of the genital products.

In the young individuals obtained, even in those with an arm length of 60 mm., there is no trace of the enlargement either of the pinnule segments or of the protecting plates, although both are visible in the older form which still shows a considerable part of the radials externally. In the regenerated arm, too, the lower pinnules are for some time quite small and inconspicuous and altogether different from those of the uninjured mature individual. This is the case even when the arm has attained almost its full size and is absolutely larger than those of other individuals not yet quite mature, but with comparatively large genital glands.

All these greatly enlarged genital pinnules are devoid of ambulacra, like the nontentaculiferous posterior arms of the Comasteridae; but at about the position of the twenty-fifth brachial there is a sudden diminution in size both of the pinnule segments and of the protecting plates, more especially of the latter. They become much smaller and relatively more numerous, while the sacculi, which are absent from the large lower pinnules begin to appear, just as they show themselves in the genital pinnules of *Glyptometra angusticalyx* from the same station, while eventually the ambulacral skeleton shows itself above the small protecting plates, as in *Glyptometra incerta*. A little farther out on the arms these protecting plates disappear, and the ambulacral skeleton comes to rest directly upon the pinnule segments. The side plates are very well differentiated and are often notched for the reception of the sacculi or of portions of them; but in other cases when the sacculi are large they are altogether covered and concealed by the side plates.

In his memoir on the stalked crinoids of the *Challenger* Expedition Carpenter noted that on the disk of *Poecilometra acoela* the double row of transversely oblong plates that generally mark the ambulacra are barely distinguishable. He also said that the fertile intrapinnular portion of the genital gland is short, thick, and rounded, and extends only over four or five of the pinnule segments.

In London I examined six specimens of Carpenter's type series and remarked that the constriction of the lower portion of the calyx seems to be a valid character for differentiating this species from *P. scalaris*.

The specimens from *Siboga* stations 122 and 124 resemble each other and do not seem to differ appreciably, in size or otherwise, from others at hand dredged by the *Challenger*. In young individuals in which the radials are still about half as large as the IBr_1 there is but little trace of the dorsolateral processes characteristic of the adults; they are only slightly evident, though they can be made out as a thickened ridge in the place they will eventually occupy. At this stage also the genital pinnules are slender and evenly tapering, showing no trace of the lateral expansion of the segments which is so marked a feature in the fully grown. As the radials become shorter the proximal border of the IBr_1 becomes produced so that it conceals the radials and the proximal edge of the centrodorsal when the animal is viewed laterally. The dorsal surface of the radials is gradually resorbed as the proximal margin of the IBr_1 is produced, so that the IBr series and arms appear to be too large for the radials and the centrodorsal, giving the appearance of having been glued upon them rather than of having grown out from them. In very large specimens the produced proximal and lateral borders of the IBr_1, which are typically smooth, become crenulate and scalloped.

Localities.—*Challenger* station 214; off the Meangis Islands (lat. 4°33′ N., long. 127°06′ E.); 914 meters; bottom temperature 5.44° C.; blue mud; February 10, 1875 [P. H. Carpenter, 1880, 1884, 1887, 1888; Hartlaub, 1891; Shipley and MacBride, 1901; Minckert, 1905; Hamann, 1907; A. H. Clark, 1907, 1909, 1912, 1913, 1918; Gislén, 1924] (9, USNM, 35659; M. C. Z., 296, 606; B. M.).

Siboga station 124; northeast of the northeastern tip of Celebes (lat. 2°27′ N., long. 125°35′ E.); 1,327 meters; stone; July 18, 1899 [A. H. Clark, 1918] (2, Amsterdam Mus.).

Siboga station 122; north of the northeastern tip of Celebes (lat. 1°58′30″ N., long. 125°00′30″ E.); 1,165–1,264 meters; stone; July 17, 1899 [A. H. Clark, 1918] (7, Amsterdam Mus.).

Geographical range.—Between northern Celebes and Mindanao, Philippines.

Bathymetrical range.—From 914 to 1,327 meters.

Thermal range.—One record, 5.44° C.

History.—In a popular article published in 1880 Dr. P. Herbert Carpenter gave a figure of part of a distal pinnule of a comatulid he identified only as "a new species of *Antedon* from the Pacific" showing the side and covering plates. In his memoir on the stalked crinoids of the *Challenger* Expedition published in 1884 he mentioned *Antedon acoela* several times, giving a specific formula (page 57, footnote 4) and discussing the peculiarities of the genital pinnules and the disk. He included a figure of the ventral view of part of an arm showing five genital pinnules, and also a lateral and ventral view of a single genital pinnule. He republished the figure of part of a distal pinnule given in 1880 lengthened so as to show four and a half pinnule segments instead of three, and thirteen side-plates instead of nine. In a paper published in 1887 Carpenter discussed the sacculi of *Antedon acoela* and republished the figure of a portion of the distal pinnule.

In his memoir on the comatulids of the *Challenger* Expedition Carpenter described *Antedon acoela* in detail and figured it on the basis of "several specimens" from station 214. In 1891 Dr. Clemens Hartlaub listed a specimen that had been presented by Carpenter to the Göttingen Museum.

Sir Arthur E. Shipley and Prof. E. W. MacBride republished one of Carpenter's figures in 1901, Dr. Wilhelm Minckert discussed the syzygies in 1905, and Dr. Otto Hamann in 1907 listed *Antedon acoela* and republished a figure of Carpenter's.

In my first revision of the old genus *Antedon* published in 1907 *Antedon acoela* was made the type of the new genus *Poecilometra*, and in my revision of the families Thalassometridae and Himerometridae published in 1909 it was listed as *Poecilometra acoela*. In my memoir on the crinoids of the Indian Ocean published in 1912 *Poecilometra acoela* was listed and the synonymy and range were given. In 1913 I published notes on six specimens from *Challenger* station 214 and compared this species with *P. scalaris*. In my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 I recorded and gave notes on seven specimens from station 122 and on two from station 124.

Prof. Torsten Gislén in 1924 discussed the peculiarities of the genital pinnules on the basis of Carpenter's description and figures.

POECILOMETRA SCALARIS (A. H. Clark)

[See vol. 1, pt. 2, figs. 118, 132, p. 79, 229, p. 186, 288, p. 221, 539–542, p. 289, 849–855, p. 412.]

Antedon scalaris A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 141 (description; *Albatross* station 4918); vol. 34, 1908, pp. 437, 493.

Poecilometra scalaris A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 362 (listed); Proc. Biol. Soc. Washington, vol. 22, 1909, p. 18 (listed); Crinoids of the Indian Ocean, 1912, p. 225 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 50 (comparison with *P. acoela*); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 190 (in key; range).

Poecilometra acoela A. H. CLARK, Proc. U. S. Nat. Mus., vol. 34, 1908, p. 265, fig. 1 (with an additional IBr ossicle), p. 318 (southern Japan).

Diagnostic features.—The profiles of the IBr series and arm are smooth and continuous, those of the two sides making with each other an angle of about 60°; the centrodorsal is of moderate size with a basal diameter of 4 mm.; the cirri are about XX, 20; and the arms are 110 mm. long.

Description.—The centrodorsal is short columnar terminating in a stellate figure with rounded angles and an elevated center bearing about its edge numerous small knoblike tubercles one at the base of each of the apical cirri. The cirrus sockets are arranged in two irregular rows and a partial third, and roughly in two or three columns in each radial area.

The cirri are about XX, 15, about 20 mm. long, moderately stout. All the segments except the basal are longer than broad, the longest about twice as long as broad, the distal only slightly shorter. There are no dorsal processes. The opposing spine is minute, and the terminal claw, which is shorter than the penultimate segment, is stout at the base but tapers to a sharp point and is moderately curved.

The radials are concealed. The IBr_1 are hemispherical with the curved side proximal. The IBr_2 (axillaries) are rhombic with the lateral angles rather broadly truncated, nearly twice as broad as long. The dorsal surface of the proximal and lateral portions of the IBr_1 and the lateral portions of the axillary is produced outward into a thin flangelike border, as are the lateral edges of the first two brachials, and of the hypozygal of the first syzygial pair, and the outer edge of the epizygal.

The 10 arms are 110 mm. long. The first two brachials are short, twice as broad as long exclusive of the lateral flanges. The third brachial (the hypozygal of the first syzygial pair) is oblong, about three times as broad as long. The fourth brachial (epizygal) is triangular, tapering to a point on the inner side of the arm. The next four brachials are triangular, about twice as broad as the median length. The ninth brachial is oblong, nearly three times as broad as long, and those following are triangular, about as broad as the long side, becoming distally very obliquely wedge-shaped and longer.

Syzygies occur between brachials 3+4, again from between brachials 9+10 to between brachials 12+13, and distally at intervals of 3 or 4 muscular articulations.

P_1 is 7 mm. long with 22 segments, slender, tapering, and almost flagellate. P_2 is shorter with 15 segments of which the first seven are short and broad, the others very small. The following pinnules to P_8 or P_9 have 10 segments of which the third-seventh are bluntly keeled and much expanded dorsoventrally and bear a large gonad protected ventrally with large plates. The terminal segments of these pinnules are minute, the basal not especially stout. The distal pinnules are 10 mm. long with 15 moderately elongated segments. The ambulacra are well plated.

The color in life is yellowish brown.

Note.—On one of the postradial series in the type specimen there is an additional element in the IBr series, a small ossicle a little more than half the size of the IBr_1 interposed between the IBr_1 and IBr_2. The first segments of the pinnules are noticeable in being larger than usual, distantly suggesting the condition in the species of Calometridae.

Locality.—Albatross station 4918; Eastern Sea about 90 miles west-southwest of Kagoshima Gulf; Gwaja Shima bearing S. 38° E., 34 miles distant (lat. 30°22′00″ N., long. 129°08′30″ E.); 660 meters; bottom temperature 5.95° C.; gray sand, globigerinae, and broken shells; August 13, 1906 [A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1915, 1918] (1, U.S.N.M., 22629).

History.—This species was originally described in 1907 under the name *Antedon scalaris* from a single specimen from *Albatross* station 4918. Later in the same year it was transferred to the new genus *Poecilometra.* In 1908 an aberrant IBr series with an additional ossicle in the type specimen was described and figured, the species being given as *Poecilometra acoela,* and later it was listed under the same name among the crinoids of Japan.

In my revision of the families Thalassometridae and Himerometridae published in 1909 *Poecilometra scalaris* was listed, and in my memoir on the crinoids of the Indian Ocean published in 1912 it was again listed and the synonymy and range were given. In my paper on the crinoids of the British Museum published in 1913 *Poecilometra scalaris* was briefly compared with *P. acoela* from *Challenger* station 214. In 1915 *P. scalaris* was again listed as a Japanese species and the range and its significance were discussed. In my memoir on the unstalked crinoids of the *Siboga* Expedition published in 1918 *scalaris* was included in the key to the species of *Poecilometra* and the synonymy and range were given.

Genus STROTOMETRA A. H. Clark

Antedon (part) P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 127, and following authors.

Charitometra (part) A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361.

Strotometra A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 19 (diagnosis; genotype *Antedon hepburniana* A. H. Clark, 1907); Crinoids of the Indian Ocean, 1912, p. 9 (absent from Australia), p. 11 (absent from the west coast of the Malay Peninsula, the Andamans, and farther west), p. 25 (range), p. 60 (in key), p. 226 (original reference; type); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 172 (in key; range), p. 191 (key to the included species).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 9; Kungl. Fysiograf. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.

Diagnosis.—The genital pinnules have the third and fourth, third–fifth, or fifth–eighth segments much broadened, the abruptly narrower tip being shorter than the expanded portion; the division series and arm bases are more or less recumbent, their profile in lateral view making a wide angle with the dorsoventral axis; there are not more than 15 cirrus segments, seldom more than 13; and the size is small, the arms not exceeding 75 mm., and rarely being more than 45 mm. in length.

Geographical range.—From Timor and the Kei Islands northward to southwestern Japan.

Bathymetrical range.—From 180 to 1,165 (?1,264) meters.

Thermal range.—One record from southwestern Japan, 11.28° C.

History.—The genus *Strotometra* was established in 1909 with the genotype *Antedon hepburniana* A. H. Clark, 1907, including also Carpenter's *Antedon parvipinna*, both of which had been previously referred to *Charitometra*. The status of the genus has remained unchanged except for the addition of two new species, *ornatissimus* and *priamus*, in 1912.

KEY TO THE SPECIES IN THE GENUS STROTOMETRA

a^1. Distal border of the second brachial everted, standing out at right angles to the dorsoventral axis of the arm as an enormous thin rounded or fan-shaped crest with a rounded or broadly scalloped edge, sometimes divided in the middle, which may reach 1.5 mm. in height, the height being three or four times the greater (outer) length of the ossicle; the fourth brachial (epizygal of the first syzygial pair) has a similar crest nearly, if not quite as large; the fifth brachial has a crest about half as high and more irregular; the sixth has a strongly produced and thickened distal edge which is coarsely scalloped; the following brachials are of the normal type with slightly produced and finely spinous distal borders (east of the northeastern end of Celebes; 1,165–1,264 meters)--ornatissimus (p. 326)

a^2. None of the brachials have everted and extravagantly developed distal borders.

  b^1. Cirri slender with all the segments beyond the second much longer than broad, the longest nearly three times as long as the median width, and moderately constricted centrally; genital pinnules with the fifth–eighth segments broadened, so that the expanded portion is preceded by a distinct peduncle; no carination of the IBr series and arms (Kei Islands to southwestern Timor; 245–595 meters)--priamus (p. 363)

  b^2. Cirri short and stout, the longest segments very little or not at all longer than broad and not constricted centrally; genital pinnules with the third–fourth or third–fifth segments broadened so that the expanded portion appears sessile; IIBr series and arms more or less distinctly carinate.

    c^1. P_1 with 20–22 segments, 6 mm. long; pinnules in the proximal portion of the arms smooth or nearly so; larger, arms 60–75 mm. long; cirri with 11–15 segments (Kei Islands to southwestern Timor; 245–520 meters)---------------------------------parvipinna (p. 365)

c^2. P_1 with 10–11 segments, 3.5 mm. long; pinnules in the proximal portion of the arms with conspicuously flaring and overlapping distal ends, appearing very rough; smaller, arms 45 mm. long; cirri with 10 segments (southwestern Japan; 180–243 meters).
hepburniana (p. 368)

STROTOMETRA ORNATISSIMUS A. H. Clark

PLATE 20, FIGURE 65

[See also vol. 1, pt. 1, figs. 101, 102, p. 163.]

Strotometra ornatissimus A. H. CLARK, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 82 (description; *Siboga* station 122); Unstalked crinoids of the *Siboga*-Exped., 1918, p. IX (ornamentation), p. 191 (in key; range), p. 192 (detailed description; station 122), fig. 10, p. 192, fig. 11, p. 193, p. 273 (listed), pl. 24, fig. 70.

Strotometra ornatissimus A. H. CLARK, Unstalked crinoids of the *Siboga*-Exped., 1918, p. 191.

Diagnostic features.—The distal edge of the second and fourth, and to a lesser extent the fifth, brachials is everted and produced at right angles to the longitudinal axis of the arm, standing up as a high, thin, rounded or fan-shaped crest; the axillaries are chevron-shaped instead of triangular; and the fourth and fifth cirrus segments are about three times as long as the median width, strongly constricted centrally with expanded distal ends.

Description.—The centrodorsal is flattened-hemispherical, 2.5 mm. in diameter at the base; the dorsal pole is slightly convex. The cirrus sockets are arranged in one and a partial second marginal row.

The cirri are about XV (there are 22 cirrus sockets but some are not full size); the longest cirrus stump is 4.5 mm. long to the distal dorsal edge of the fifth (the last remaining) segment. The first segment is about twice as broad as long; the second has the median length about equal to the median breadth and is centrally constricted with the distal border produced, especially ventrally where it overlaps the proximal end of the segment succeeding; the third is about twice as long as the proximal width, strongly constricted centrally with the distal end prominent as in the second; the fourth is about three times as long as the median width but otherwise similar to the third; and the fifth is similar to the fourth but not quite so much constricted centrally and hence appearing slightly broader in lateral view.

The radials are just visible over the rim of the centrodorsal. The IBr_1 are short, about four times as broad as the median length, with the proximal border produced into a thin straight margin and the lateral borders slightly more produced and turned outward. The IBr_2 (axillaries) are broadly chevron-shaped with the lateral edges, which are half again as long as those of the IBr_1, turned outward, unmodified, or with two or three broad scallops; the lateral thirds of the proximal border are produced and extended downward over the distal border of the IBr_1; these have a scalloped or tubercular edge which is nearly parallel to the concave distal edge opposite. The distal edges of the axillaries are plain and unmodified.

The 10 arms are about 40 mm. long. The first brachials have the proximal and distal edges parallel, the outer edge slightly produced and faintly scalloped, and the inner edges in apposition, in their distal half everted and scalloped; a corresponding length of the inner portion of the distal edge is similarly everted and scalloped, and the inner distal angle is rounded and produced into a thin rounded process with a more or less scalloped border; the proximal border and the distal border except for the part mentioned are unmodified. The second brachial is about the length of the first, and is slightly wedge-shaped; the distal edge is everted and stands out at right angles to the axis of the arm in the form of an enormous thin rounded or fan-shaped crest with a rounded or broadly scalloped edge, sometimes divided in the middle, which may reach 1.5 mm. in height, or from three to four times the greater (outer) length of the ossicle; the proximal outer corner of the ossicle is slightly produced backwards over the distal outer corner of the first brachial, and is scalloped or slightly tuberculated. The produced inner distal angles of the first brachials reach as far as the base of the crest. The third brachial (the hypozygal of the first syzygial pair) is oblong, very short, five or six times as broad as long, and is unmodified. The fourth brachial (the epizygal of the first syzygial pair) is very short, little if any longer than the third (hypozygal), oblong, with the distal border everted and produced into an enormous crest similar to, and nearly or quite as large as, that on the second brachial. The fifth brachial is slightly wedge-shaped, with a crest about half as high as that on the brachial preceding and more irregular. The sixth brachial has a strongly produced and thickened distal edge which is coarsely scalloped. The seventh brachial is slightly wedge-shaped, from two to two and one-half times as broad as long, with the distal edge slightly produced in the direction of the axis of the arm and finely spinous. After the tenth or twelfth the brachials become triangular, about as long as broad, and after four or five more very obliquely wedge-shaped and longer than broad, and distally longer and less obliquely wedge-shaped. Beyond the sixth the brachials are almost smooth, with only slightly produced and finely spinous distal edges.

P_1 is about 4.5 mm. long with about 13 segments of which the first two are broader than long with rounded dorsal processes, the third is slightly longer, the fourth is about as long as broad, and those beyond the seventh are slightly longer than broad. P_2 is about 4 mm. long, composed of 12 segments, and is similar to P_1 but with slightly longer distal segments. The genital pinnules are about 4 mm. long with the fourth, fifth, and sixth segments enormously expanded, roofing over the gonads, which are also protected ventrally by strong calcareous plates of irregular shape; the seventh and following segments are small and slender. On one arm P_1 and P_2, as well as the pinnules following, bear gonads.

Locality.—*Siboga* station 122; Celebes Sea (lat. 1°58′30″ N., long. 125°00′30″ E.); 1,165–1,264 meters; stone; July 17, 1899 [A. H. Clark, 1912, 1918] (1, Amsterdam Mus.).

History.—This species is known only from the single specimen dredged by the *Siboga* at station 122, originally described in 1912 and redescribed and figured in 1918.

STROTOMETRA PRIAMUS A. H. Clark

PLATE 31, FIGURE 97

[See also vol. 1, pt. 2, fig. 230, p. 188.]

Strotometra priamus A. H. CLARK, Proc. Biol. Soc. Washington, vol. 25, 1912, p. 81 (description; *Siboga* station 266); Unstalked crinoids of the *Siboga*-Exped., 1918, p. 192 (in key; range), p. 194 (detailed description; stations 266, 297), p. 275 (listed), pl. 24, figs. 64, 65.

Diagnostic features.—The cirri are slender, all the segments beyond the second much longer than broad, the longest being nearly three times as long as the median width and constricted centrally; the expanded portion of the genital pinnules is preceded by usually four unmodified segments so that it appears pedunculated; and there is no carination of the IBr series and arms.

Description.—The centrodorsal is very low, low-hemispherical or almost discoidal, from 1.5 to 2.0 mm. in diameter. The cirrus sockets are arranged in one and a partial second irregular and closely crowded rows.

The cirri are XVII, 11–12 (usually 11), from 8 to 11 mm. long, slender, with elongated segments. The first segment is very short, dorsally expanded into a rounded knoblike process; the second is not quite so long as broad; the third is twice as long as the median width; the fourth and fifth are nearly three times as long as the median width; and the remainder are very slightly shorter, becoming a trifle longer again, about two and one-half times as long as broad, on the antepenultimate and penultimate. The penultimate segment is of lesser width in lateral view than those preceding. The third and following segments are moderately constricted centrally with prominent distal ends, this feature decreasing distally. The segments bear no dorsal spines or other prominences. The opposing spine is prominent, terminal, directed obliquely forward; its proximal profile is convex, its distal profile concave, and its base occupies only slightly more than one-third of the dorsal surface of the penultimate segment. The terminal claw is about as long as the penultimate segment and is moderately stout and moderately and evenly curved.

The ends of the basal rays are visible as small but prominent tubercles in the angles of the calyx.

The radials are entirely concealed by the centrodorsal. The IBr_1 are short, about four times as broad as long in the median line; the proximal border is slightly produced, slightly convex, but usually becoming straight in the lateral quarters; the lateral edges are in close apposition with those of their neighbors, and are widely divergent and produced and everted as in *Glyptometra lateralis;* the distal edge is sometimes obscurely scalloped in the lateral thirds, the median third being slightly excavated for the reception of a rounded posterior process from the axillary. The IBr_2 (axillary) is exceedingly short, about two and one-half times as broad as long; its lateral edges resemble those of the IBr_1 but are only about half as long.

The 10 arms are about 40 mm. long. The first brachials are in close apposition with their neighbors both internally and externally; their proximal and distal borders are parallel, the proximal being slightly everted; their outer borders are produced and everted like the outer borders of the preceding ossicles; the inner borders are similarly everted, though not so much so; the synarthrial tubercles, though small and well rounded, are rather prominent. The second brachials are similar to the first, but are about twice as long externally as internally. The first syzygial pair (composed of brachials 3+4) is roughly oblong, about two and one-half times as broad as long, with the lateral edges modified as in the ossicles preceding. The next three brachials are wedge-shaped, about twice as broad as the maximum length, with the dorsal surface usually concave and the distal edge therefore prominent. After the tenth the brachials become triangular and about as long as broad, later very obliquely wedge-shaped, and toward the ends of the arms twice as long as broad. Beyond the second syzygy the brachials have slightly produced and very finely spinous distal ends. There is no carination of the division series and arms.

P_1 is slender and delicate, 6 mm. long with 35 segments of which the seventh or eighth and following are about as long as broad; except for the absence of the expansion of the first two segments it resembles P_1 in *Calometra*. P_2 in the type specimen is 6 mm. long with 18 segments of which the sixth–eleventh are greatly produced ventrally forming a roof over the gonads, which are further protected by a heavy ventral plating; the seven terminal segments are very small and delicate. P_3 is similar, 4.5 mm. long with 14 segments of which the sixth–tenth are expanded to protect the gonads. P_4 is 4 mm. long with 13 segments of which the fifth–ninth are expanded. P_5 is 3 mm. long, small and moderately stout, with 10 segments none of which are expanded. The pinnules following gradually increase in length, the distal pinnules being 5 mm. long with 11 or 12 segments. In other specimens the genital pinnules usually have the fifth–eighth segments expanded, or in small specimens the fifth–sixth or fifth–seventh.

Notes.—One of the specimens from the Danish Expedition to the Kei Islands station 1 has the arms 45 mm. long; the other two are smaller.

The specimen from the Danish Expedition to the Kei Islands station 56 has the arms 45 mm. long and the cirri 10 mm. long with 10–11 (usually 10) segments.

Localities.—*Siboga* station 266; Kei Islands (lat. 5°56′30″ S., long. 132°47′42″ E.); 595 meters; gray mud with coral and stones; December 19, 1899 [A. H. Clark, 1912, 1918] (39, U.S.N.M., E. 427; Amsterdam Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 1; 370–400 meters; mud; March 30, 1922 (3, U.S.N.M., E. 3151; C. M.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 56; 245 meters; mud; May 10, 1922 (1, C. M.).

Siboga station 297; Lesser Sunda Islands, north of Rotti (lat. 10°39′ S., long. 123°40′ E.); 520 meters; soft gray mud with a brown upper layer; January 27, 1900 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Geographical range.—From the Kei Islands to the vicinity of southwestern Timor.

Bathymetrical range.—From 245 to 595 meters.

History.—*Strotometra priamus* was originally described in 1912 from a specimen from *Siboga* station 266. It was redescribed and figured in 1918 when 39 specimens from station 266 and one from station 297 were recorded.

STROTOMETRA PARVIPINNA (P. H. Carpenter)

[See vol. 1, pt. 2, fig. 231, p. 191.]

Antedon parvipinna P. H. Carpenter, *Challenger* Reports, Zoology, vol. 26, pt. 60, 1888, p. 127 (description; *Challenger* station 192), pl. 15, fig. 9.—Hartlaub, Bull. Mus. Comp. Zool., vol. 27, No. 4, 1895, p. 130 (systematic and bathymetrical relationships).—Hamann, Bronn's Klassen und Ordnungen des Tier-Reichs, vol. 2, Abt. 3, 1907, p. 1578 (listed).—A. H. Clark, Crinoids of the Indian Ocean, 1912, p. 33 (identity).

Charitometra parvipinna A. H. Clark, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed).

Strotometra parvipinna A. H. Clark, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 20 (listed); Crinoids of the Indian Ocean, 1912, p. 33 (identity), p. 226 (synonymy; locality); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 50 (published reference to specimen in the B. M.; *Challenger* station 192; characters, and comparison with *S. hepburniana*); Unstalked crinoids of the *Siboga*-Exped., 1918, p. IX (relationship with *S. hepburniana*), p. 192 (in key; range), p. 194 (references; notes; Stas. 254, 297), pp. 274, 275 (listed).—Gislén, Ark. Zool., vol. 19, No. 32, Feb. 20, 1928, p. 9, No. 44 (notes); Kungl. Fysiogr. Sällsk. Handl., new ser., vol. 45, No. 11, 1934, p. 18.

Diagnostic features.—The cirri are short and stout with the longest segments little, if any, longer than broad and not constricted centrally; the expanded portion of the genital pinnules is preceded by two unmodified segments so that it appears sessile; the pinnules on the proximal portion of the arms are smooth or nearly so; P_1 is 6 mm. long with 20–22 segments; the arms are 60–75 mm. long; and the cirri have 11–15 segments.

Description.—The centrodorsal is discoidal. According to the figure the cirri are arranged in a partially double marginal row.

The cirri are about XV, about 15; the segments are stout, the fifth and sixth slightly longer than broad.

Carpenter says that minute plates, probably the basal rays, rest upon the interradial angles of the centrodorsal and separate the IBr_1.

The IBr_1 are nearly oblong, and are in close lateral contact beyond the ends of the basal rays. The IBr_2 (axillaries) are short and broad with very open angles and are in close apposition. Both the elements of the IBr series have traces of a median keel which is continued on to the arm bases.

The 10 arms are probably 60 mm. long. The first brachials are nearly oblong, with the outer sides flattened. The inner sides of the second and third (hypozygal) brachials are also flattened. The brachials after the eighth are triangular, at first considerably broader than long, but gradually becoming more nearly as long as broad, and finally wedge-shaped.

Syzygies occur between brachials 3+4, again from between brachials 9+10 to between brachials 13+14, and the distal intersyzygial interval is from 6 to 10 muscular articulations.

P_1 and P_a are relatively small and are of tolerably equal size, with little more than 12 short segments. P_2 and P_b have longer segments, and the pinnules of the seventh and following brachials have the third and next two or three segments considerably expanded so as to enclose the gonads, which are also protected by plates. The fourth segment is larger than the rest, but not markedly so.

The disk is 4 mm. in diameter. The disk and arms are distinctly, though not extensively, plated. The pinnule ambulacra have fairly defined side plates with intervening sacculi, which are also abundant in the plating over the gonads.

The color in alcohol is white.

Notes.—Carpenter said that in his specimen P_1 is relatively shorter and much less flagellate than in *Glyptometra tuberosa*, consisting of a smaller number of segments and having an altogether stiffer appearance.

In a specimen at hand P_1 is 6 mm. long with 20–22 segments; it tapers rapidly in the first six segments and is very slender from the seventh segment onward. It is possible that in Carpenter's specimen P_1 and P_a were broken. In the present specimen P_2 is about as long as P_1 with 13 segments; it tapers evenly from the base to the tip and because of this appears considerably stouter than P_1. The genital pinnules have the third–fifth segments much expanded. The pinnule segments are without produced and prominent distal ends. The arms are faintly carinate. None of the cirrus segments are longer than broad.

After examining the type specimen in the British Museum I wrote that this species is closely related to *S. hepburniana;* it is a large form with much less expanded genital pinnules. I should have said that the enlarged segments of the genital pinnules are not broadened laterally as in *S. hepburniana* but their sides are produced downward at a considerable angle so that in a dorsal view they appear to be much less expanded. There is a delicate median carination on the elements of the IBr series and on the first two brachials which is easily traceable all along the arm. P_2 is rather more like P_1 than like P_3, though it is larger and has some of the characteristics of the latter. There are 11–13 cirrus segments.

Gislén wrote of the same specimen that the cirri have about 15 segments as stated by Carpenter.

Five of the specimens from the Danish Expedition to the Kei Islands station 56 show the following features: (1) Arms about 70 mm. long, 11–12 cirrus segments; (2) arms about 70 mm. long, 12 cirrus segments; (3) arms about 55 mm. long, 12 cirrus segments; (4) arms about 75 mm. long, 11–12 cirrus segments; (5) arms about 75 mm. long, 11 cirrus segments. The four other specimens are similar.

The largest specimen from *Siboga* station 297 is relatively large and stout with the arms 75 mm. long. The surface of the dorsal pole of the centrodorsal and of the radials and the IBr_1 is very thickly covered with irregular tubercles so that it appears more or less spongelike. The borders of the ossicles of the IBr series and of the first two brachials are thickened and slightly everted. The IBr_2 (axillary) has a rather high median keel. The following ossicles have a prominent rounded tubercle which becomes a low broad carinate process on the triangular brachials. The cirri are XVI, 12–13; the longest proximal segments (the third and fourth) are slightly longer than broad, and the distal segments are slightly broader than long. P_1 has 17–19 segments.

Another specimen similar to the preceding but with the arms only 60 mm. long has the modification of the surface of the radials and IBr_1 not so strongly marked. The cirri are X, 12.

A third is similar to the last, but the modification of the surface of the radials is scarcely noticeable. The cirri are X, 11–12. All the others except the following resemble this.

A very interesting individual with the arms 65 mm. long has the IBr_1 with a high rounded median keel and everted lateral borders. On either side of the median keel there are from two to five high rounded tubercles. The type of ornamentation as a whole strongly suggests the condition found in *Glyptometra tuberosa.* The IBr axillary has the borders slightly everted and the distal borders margined with confluent tubercles which rapidly diminish in width from the median line to the outer angles.

Localities.—Siboga station 254; Kei Islands (lat. 5°40′ S., long. 132°26′ E.); 310 meters; fine gray mud; December 10, 1899 [A. H. Clark, 1918] (1, Amsterdam Mus.).

Danish Expedition to the Kei Islands; Dr. Th. Mortensen; station 56; 245 meters; mud; May 10, 1922 (9, U.S.N.M., E. 3142; C. M.).

Challenger station 192; near the Kei Islands (lat. 5°49′15″ S., long. 132°14′15″ E.); 256 meters; blue mud; September 26, 1874 [P. H. Carpenter, 1888; Hartlaub, 1895; Hamann, 1907; A. H. Clark, 1907, 1909, 1912, 1913, 1918; Gislén, 1928, 1934] (1, B. M.).

Siboga station 297; Lesser Sunda Islands, north of Rotti (lat. 10°39′ S., long. 123°40′ E.); 520 meters; soft gray mud with a brown upper layer; January 27, 1900 [A. H. Clark, 1918] (6, U.S.N.M., E. 418; Amsterdam Mus.).

Geographical range.—From the Kei Islands to southwestern Timor.

Bathymetrical range.—From 245 to 520 meters.

History.—*Antedon parvipinna* was described and figured by Dr. P. Herbert Carpenter in his report on the comatulids of the *Challenger* Expedition published in 1888 on the basis of a single specimen from station 192. Dr. Clemens Hartlaub in 1895 discussed its systematic and bathymetrical relationships, and in 1907 it was listed by Dr. Otto Hamann.

In my first revision of the old genus *Antedon* published in 1907 *parvipinna* was removed to the new genus *Charitometra*, and in my revision of the families Thalassometridae and Himerometridae published in 1909 it was assigned to the new genus *Strotometra*. In my memoir on the crinoids of the Indian Ocean published in 1912 *Strotometra parvipinna* was listed and the synonymy and locality were given. In 1913 I published a brief note on the type specimen from *Challenger* station 192 which I had examined at the British Museum in 1910, comparing it with *S. hepburniana*. In 1918 in my memoir on the unstalked crinoids of the *Siboga* Expedition *parvipinna* was included in the key to the species of *Strotometra*, and one specimen was recorded from station 254 and six from station 297, notes being given on some of the latter.

Prof. Torsten Gislén in 1928 gave additional notes on the type specimen in the British Museum, and in 1934 he classified the arm division of *Strotometra parvipinna* as belonging to the *Monachometra fragilis* type I.

STROTOMETRA HEPBURNIANA (A. H. Clark)

PLATE 31, FIGURES 95, 96; PLATE 32, FIGURE 104

[See also vol. 1, pt. 2, figs. 232, p. 192, 808–811, p. 385.]

Antedon hepburniana A. H. CLARK, Proc. U. S. Nat. Mus., vol. 33, 1907, p. 139 (description; *Albatross* station 4890).

Charitometra hepburniana A. H. CLARK, Smithsonian Misc. Coll., vol. 50, pt. 3, 1907, p. 361 (listed); Proc. U. S. Nat. Mus., vol. 34, 1908, p. 318 (Japan); Geogr. Journ., vol. 32, No. 6, 1908, p. 603 (type of a non-oceanic group).

Strotometra hepburniana A. H. CLARK, Proc. Biol. Soc. Washington, vol. 22, 1909, p. 20 (listed); Vid. Medd. Nat. Foren. København, 1909, p. 187 (south of the Goto Islands, 100 fathoms; description; comparison with the type); Crinoids of the Indian Ocean, 1912, p. 226 (synonymy; locality); Proc. Biol. Soc. Washington, vol. 26, 1913, p. 179 (range in eastern Asia); Smithsonian Misc. Coll., vol. 61, No. 15, 1913, p. 50 (comparison with *S. parvipinna*); Journ. Washington Acad. Sci., vol. 5, No. 6, 1915, p. 215 (southern Japanese species; range and its significance); Unstalked crinoids of the *Siboga*-Exped., 1918, p. IX (relationship with *S. parvipinna*), p. 192 (in key; range), p. 194 (references); Smithsonian Misc. Coll., vol. 72, No. 7, 1921, pl. 2, fig. 28 (side plate).

Diagnostic features.—The cirri are short and stout, the longest segments slightly longer than broad and not constricted centrally; the expanded portion of the genital pinnules is preceded by two unmodified segments so that it appears sessile; the segments of the pinnules in the proximal portion of the arms have conspicuously flaring and overlapping distal ends so that the pinnules appear very rough; P_1 is 3.5 mm. long with 10–11 segments; the arms are 45 mm. long; and the cirri have 10 segments.

Description.—The centrodorsal is low-hemispherical without interradial processes and with the large dorsal pole roughened. There is a single row of 10 cirrus sockets, two to each radial area.

The cirri are X, 10, about 7 mm. long, short and stout. The first segment is very short, the second is about twice as long, the third is about twice as long as the second, and about as long as broad. The segments following are somewhat longer than broad. The penultimate segment bears a prominent opposing spine. The terminal claw is about as long as the penultimate segment and is stout and moderately curved.

The ends of the basal rays are visible as interradial tubercles.

The radials are short and bandlike with curved proximal and distal borders; the lateral edges are raised into blunt tubercles. The IBr_1 are somewhat longer, about four times as broad as long, and are bluntly carinate. The IBr_2 (axillaries) are short, low-triangular, about three times as broad as long, with a low blunt median keel. The ossicles of the IBr series and first four or five brachials have slightly flattened sides.

The 10 arms are 45 mm. long. The earlier brachials are oblong with a blunt median keel, becoming wedge-shaped after the fifth, after the ninth nearly triangular and somewhat broader than long, and elongate and wedge-shaped again distally.

Syzygies occur between brachials 3+4, again at about brachials 11+12, and distally at intervals of 4 or 5 muscular articulations.

P_1 is 2.5 mm. long with 10–13 short segments of which the first four or five are considerably broader than the others; the segments are about as long as broad, rounded trapezoidal in shape, making the distal corners very prominent. P_a is similar to P_1 but slightly shorter with the basal segments not so much enlarged. P_2 is 2 mm. long with 6 segments of which the third and fourth are greatly expanded laterally. The next five pinnules are similar to P_2 with 6 or 7 segments of which the third and fourth and sometimes also the fifth are greatly expanded laterally and support the large globose gonads. Distally the pinnules become uniformly tapering and slender, reaching 3.5 mm. in length with about 12 segments of which the first is short, the second is about as long as broad, and the remainder are somewhat longer than broad.

The disk is scantily plated. Side and covering plates are well developed along the brachial and pinnule ambulacra, and the gonads are protected ventrally by a pavement of large irregular plates.

The color in life is bright yellow.

Notes.—The specimen from south of the Goto Islands in the Copenhagen Museum is considerably larger than those obtained by the *Albatross* in the same general region. The arms are about 60 mm. long. P_2 is more nearly like P_1 than in the *Albatross* specimens, in which P_2 resembles P_3. All the brachials except the first three or four have strongly produced and overlapping distal ends. The color of the specimen is dull orange, possibly due to a slight alkalinity in the containing alcohol.

Localities.—*Albatross* station 4890; 10 miles southwest of the Goto Islands; Ose Saki Light bearing N. 2° W., 10 miles distant (lat. 32°26′30″ N., long. 128°36′30″ E.); 243 meters; bottom temperature 11.28° C.; rocky bottom; August 9, 1906 [A. H. Clark, 1907, 1908, 1909, 1912, 1913, 1915, 1918, 1921] (5, U.S.N.M., 22635 [type], 35692).

Eastern Sea south of the Goto Islands (lat. 32°10′ N., long. 128°20′ E.); 180 meters; Captain Schönau, April 23, 1898 [A. H. Clark, 1909, 1913, 1915, 1918] (1, C. M.).

Eastern Asia (1, C. M.)

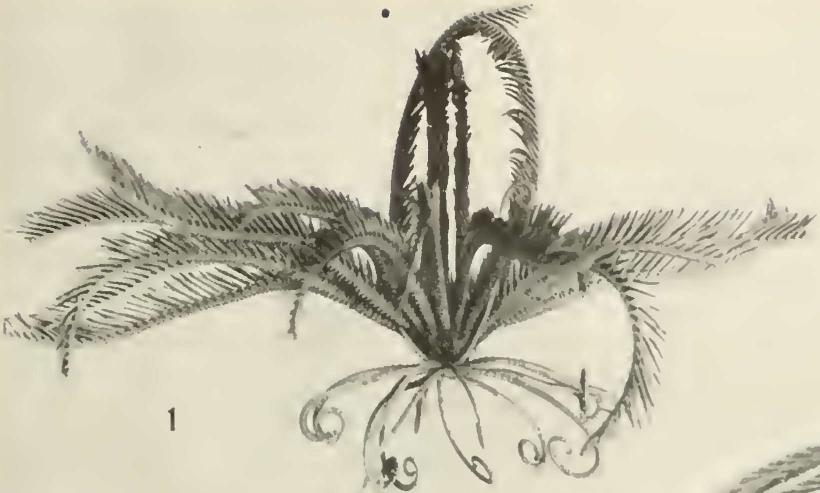
Geographical range.—Known only from the Eastern Sea south of the Goto Islands.

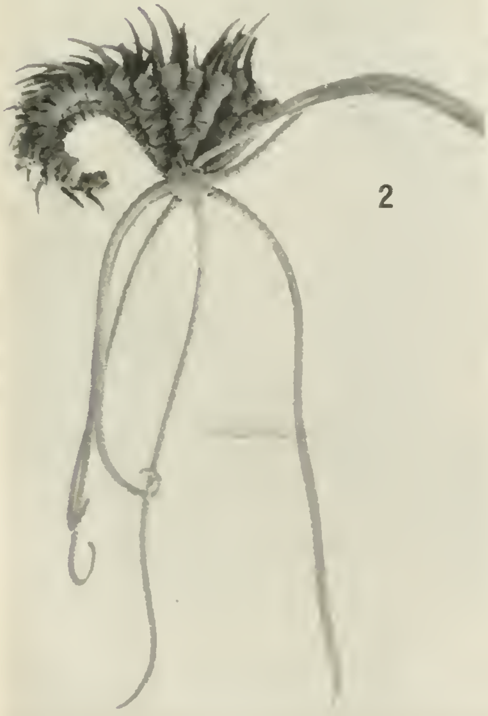
Bathymetrical range.—From 180 to 243 meters.

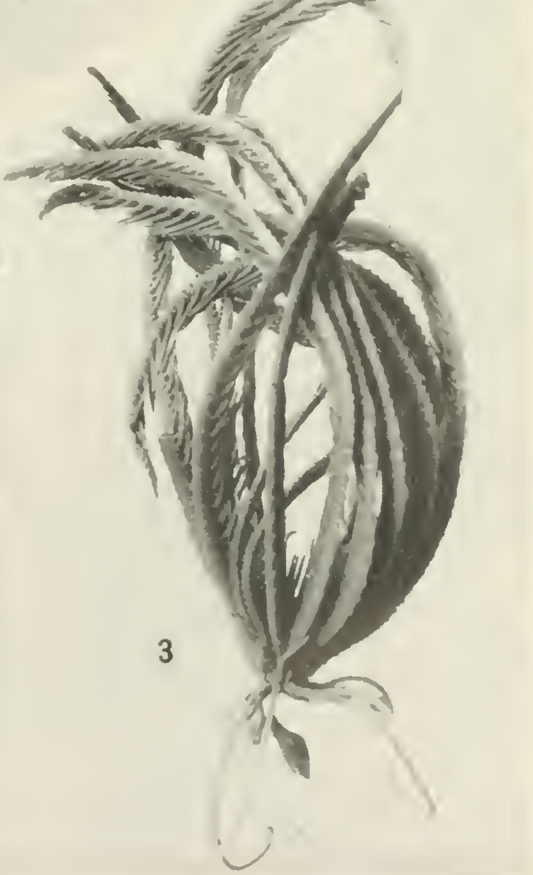
Thermal range.—One record, 11.28° C.

History.—*Antedon hepburniana* was originally described in 1907 from a specimen dredged by the *Albatross* at station 4890. In my first revision of the genus *Antedon* published later in the same year *hepburniana* was removed to the new genus *Charitometra,* and in 1908 *Charitometra hepburniana* was listed as a Japanese species. In another paper published toward the end of 1908 *Charitometra hepburniana* was given as a representative of a nonoceanic group of comatulids.

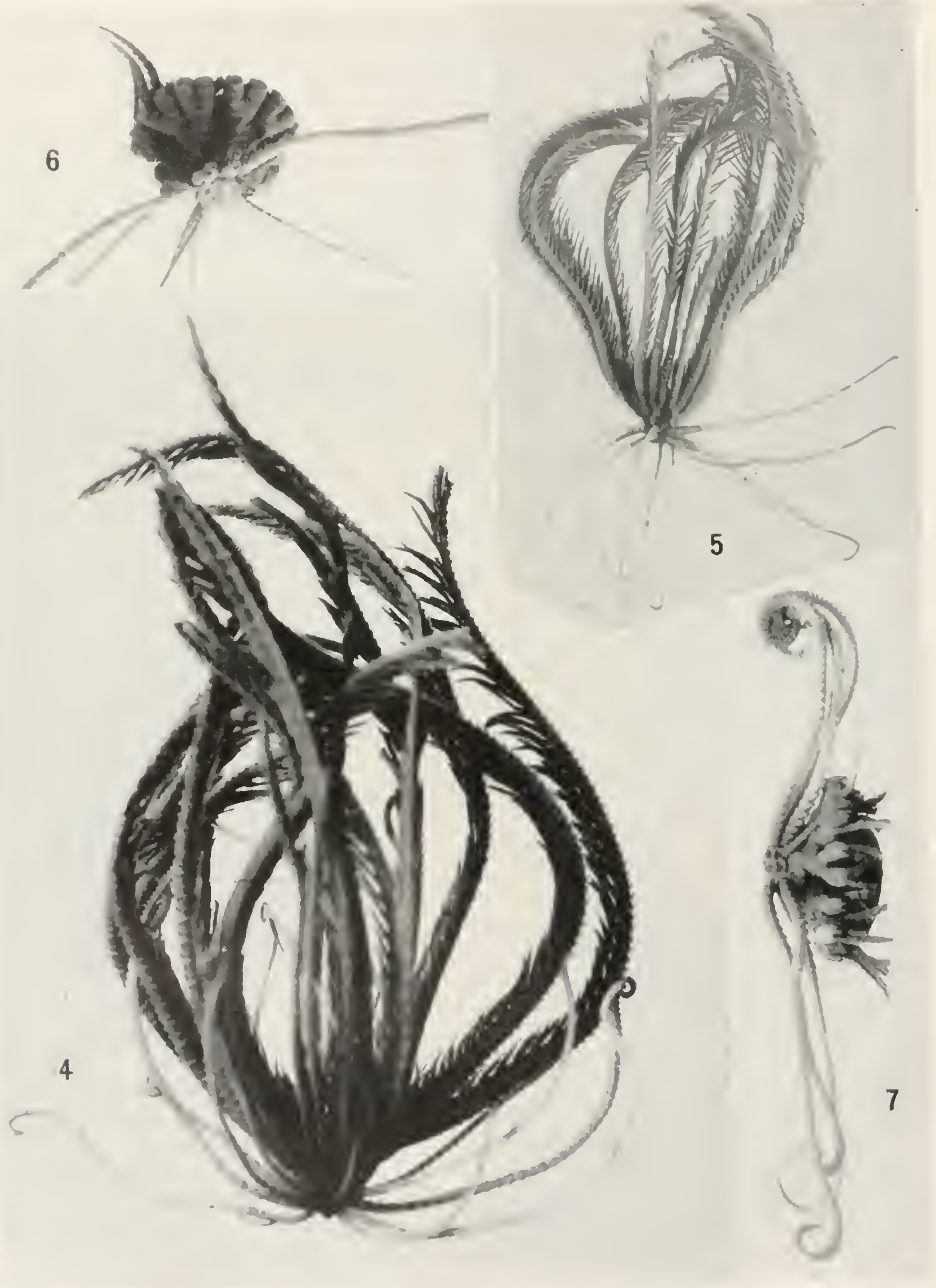
In my revision of the families Thalassometridae and Himerometridae published in 1909 *Antedon hepburniana* was made the type of the new genus *Strotometra,* and later in the same year a specimen of *Strotometra hepburniana* was recorded from south of the Goto Islands and notes were given on it. In my memoir on the crinoids of the Indian Ocean published in 1912 *Strotometra hepburniana* was listed and the synonymy and range were given, and this information was repeated in 1913. In 1913 also, in a paper on the crinoids of the British Museum, *S. parvipinna* was compared with *S. hepburniana.* In 1915 *S. hepburinana* was listed as a southern Japanese species, and the range and its significance were discussed. In my report on the unstalked crinoids of the *Siboga* Expedition published in 1918 *hepburniana* was included in the key to the species of *Strotometra,* the synonymy and range were given, and its relationship to *S. parvipinna* was mentioned. In a popular article on sea lilies and feather stars published in 1921 the side plates of *Strotometra hepburniana* were figured, the two figures given (under one number) being copies of figures 810 and 811 on page 385 of Part 2.


1

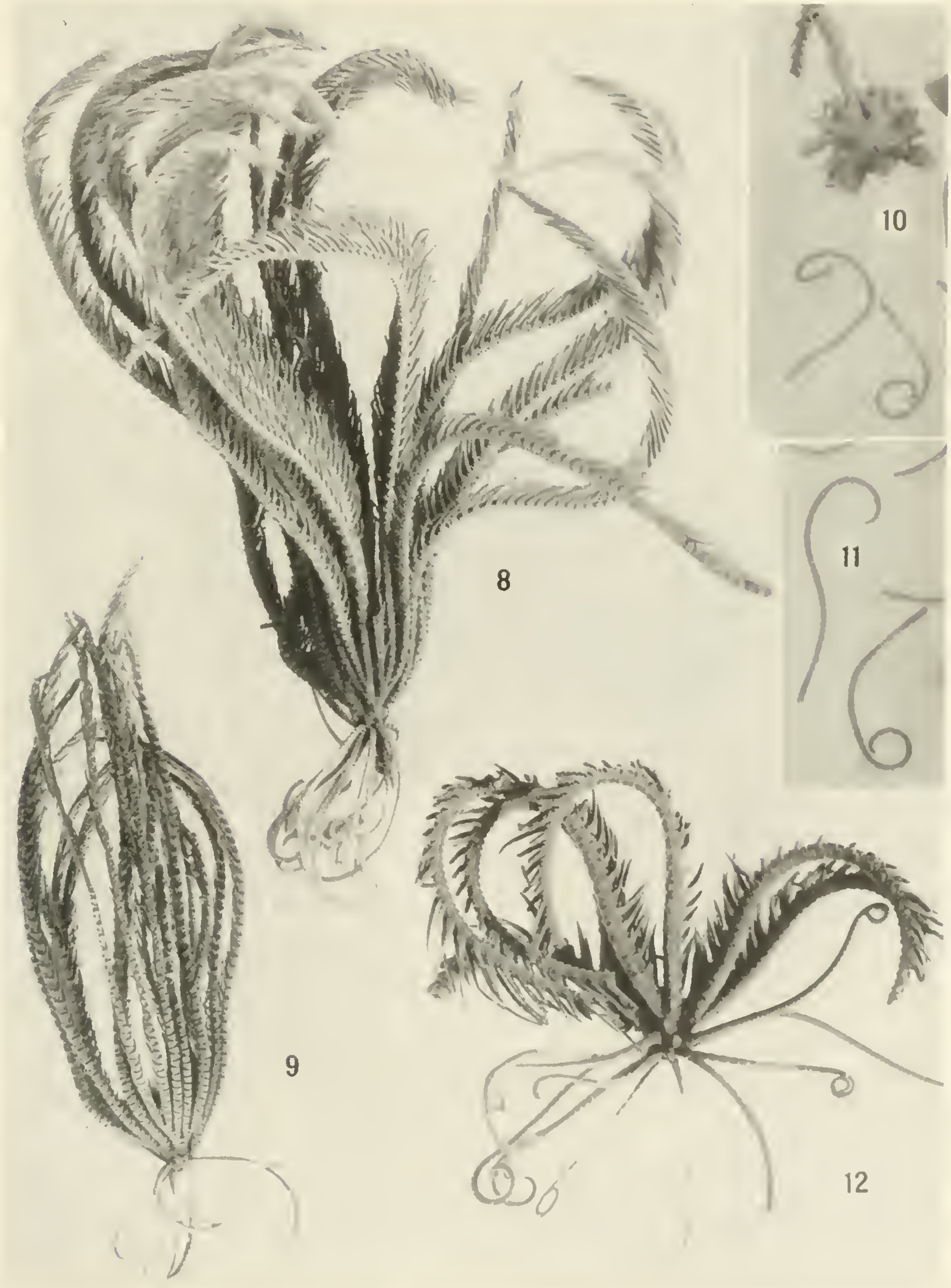

2


3

1, *Stenometra snelliusi:* Type specimen from *Willebrord Snellius* station 253* (L.M.).
2, 3, *Stenometra quinquecostata:* 2, Type specimen of *Stenometra diplax* from Rotti Strait in 183 meters, × 2 (B.M.);
3, specimen of *S. cristata* from *Albatross* station 5275, × 2 (U.S.N.M., 35598).



4, 6, 7. *Stenometra quinquecostata:* 4, Type specimen of *Stenometra cristata* from *Albatross* station 5275, × 2 (U.S.N.M., 27501); 6, 7, specimen from between Timor and Rotti in 183 meters, × 2 (B.M.).
5, *Stenometra diadema:* Specimen from the Eastern Sea near Nagasaki in 311 meters (C.M.).

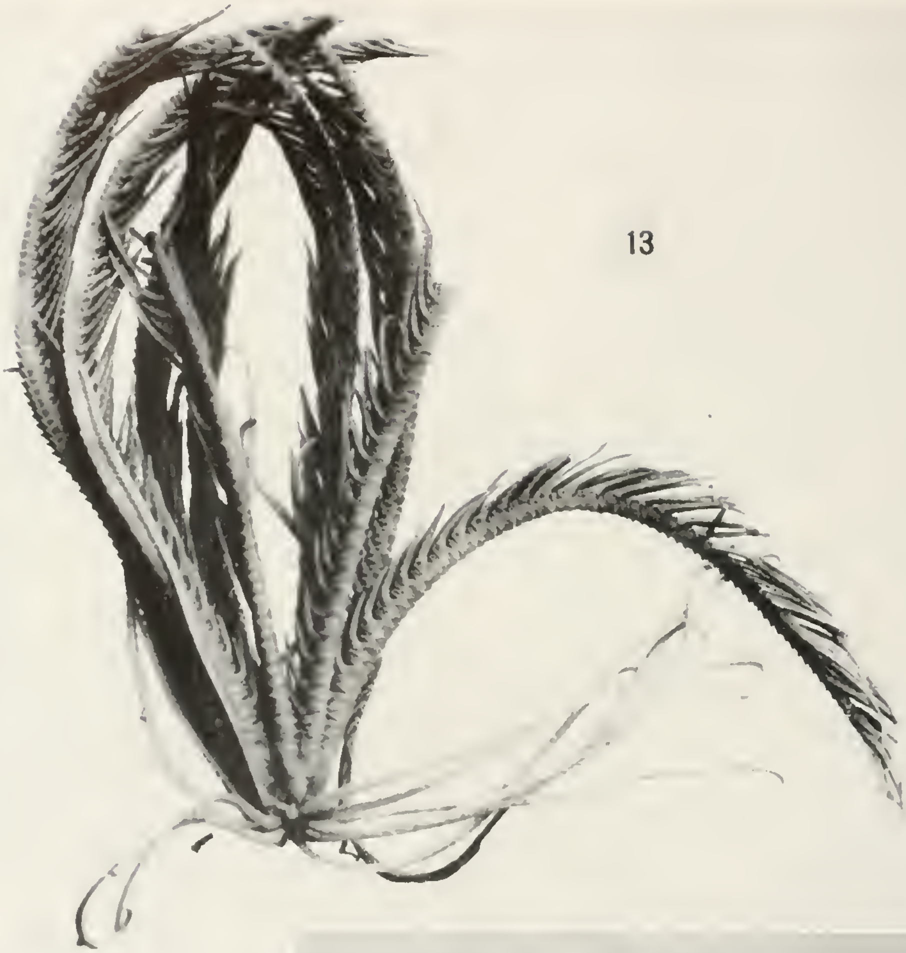


8, *Stylometra spinifera* (U.S.N.M.).

9, *Cosmiometra delicata:* Type specimen from *Albatross* station 3963 (U.S.N.M., 22690).

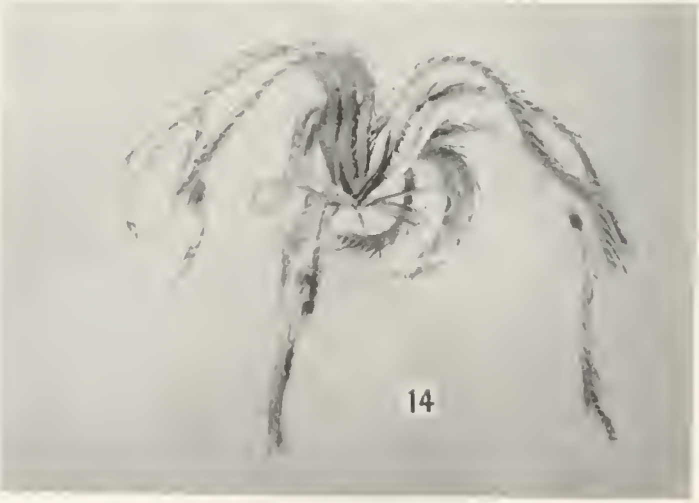
10, 11, *Cosmiometra conifera:* 10, Type specimen from Japan (Berl. Mus., 2830); 11, additional cirri from the type specimen.

12, *Daidalometra arachnoides:* Type specimen of *Stenometra acuta* from *Siboga* station 294, × 2 (Amsterdam Mus.).



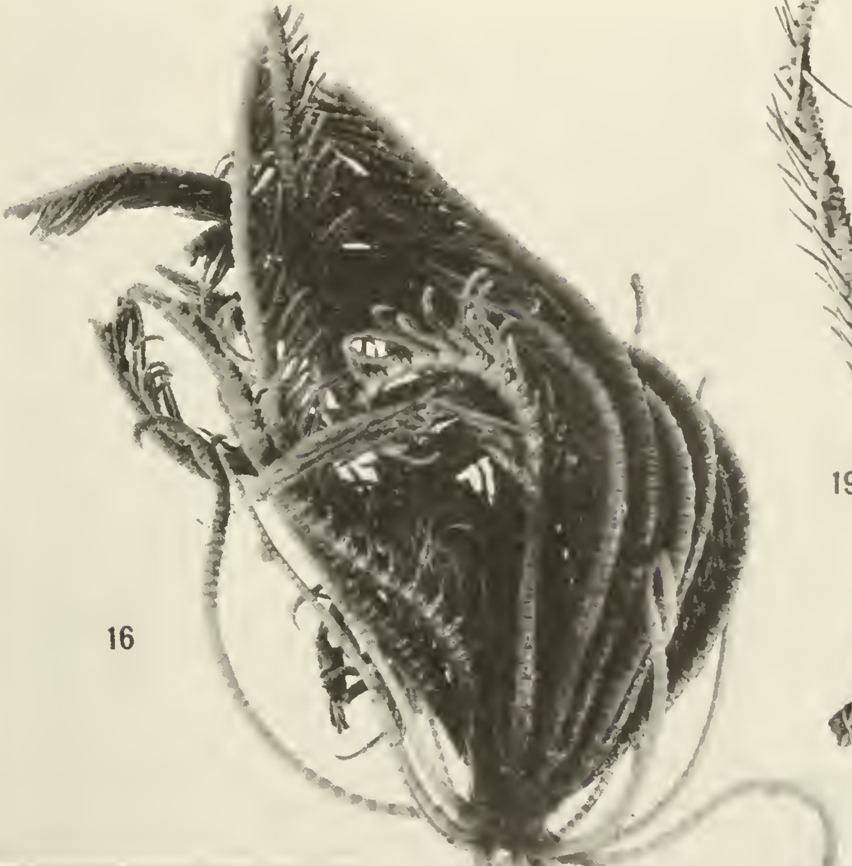
13

15

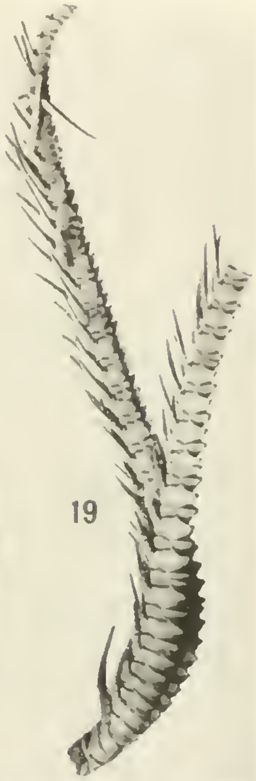


14

13. *Daidalometra hana:* Type specimen from *Albatross* station 4903, × 2 (U.S.N.M., 22632).
14. *Cosmiometra iole:* Type specimen from Zamboanga, Mindanao, Philippines, in 292–365 meters (C.M.).
15. *Cosmiometra conifera:* Type specimen from Japan, ventral view (Berl. Mus., 2830). (See pl. 3, figs. 10, 11.)

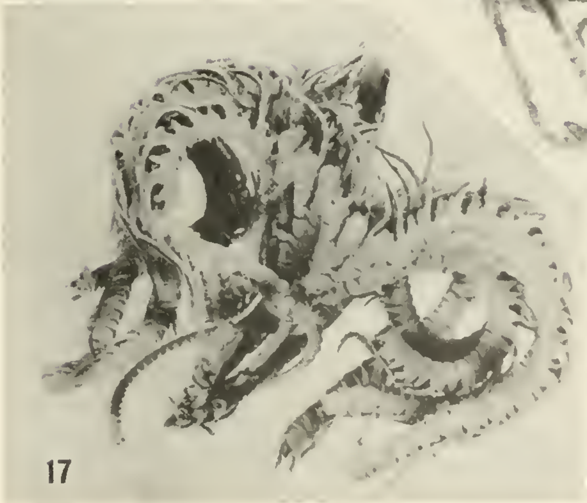


16

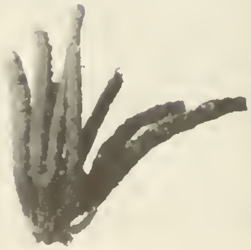


19

20



17



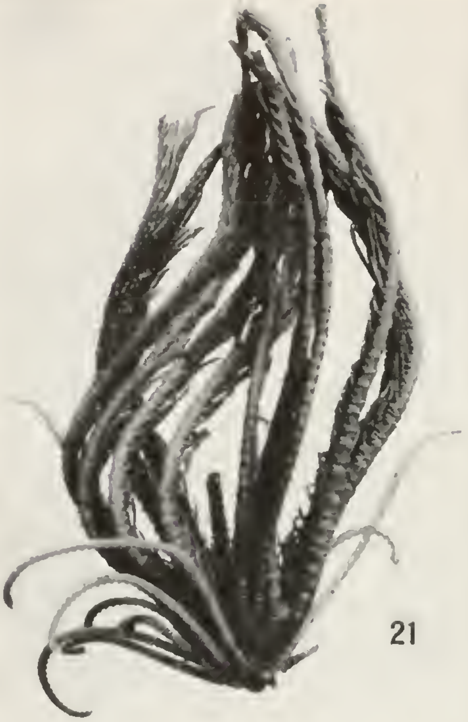
18

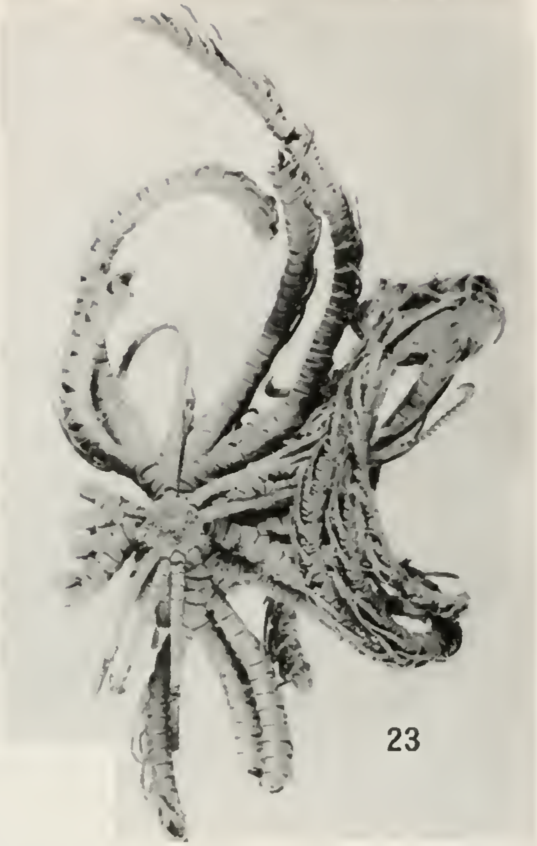
16, *Cosmiometra philippinensis:* Type specimen of *Cosmiometra helene* from *Siboga* station 253, × 2 (Amsterdam Mus.).

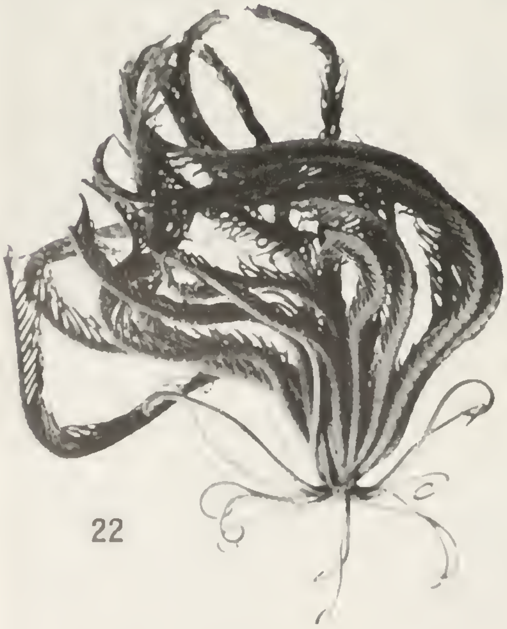
17, *Cosmiometra leilae:* Type specimen from *Investigator* station 465, × 2 (I.M.).

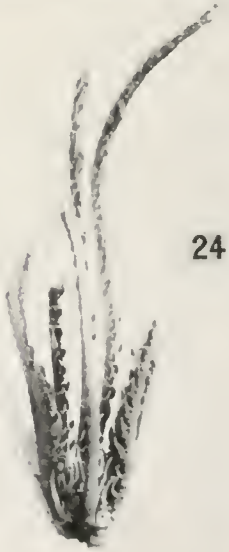
18, *Stiremetra decora:* Type specimen from *Albatross* station 4107, × 2 (U.S.N.M., 36079).

19, 20, *Parametra orion:* Pinnules from a specimen from *Albatross* station 4934; 19, proximal pinnules; 20, distal pinnules, × 2. (Entire specimen shown on pl. 8, fig. 27.)

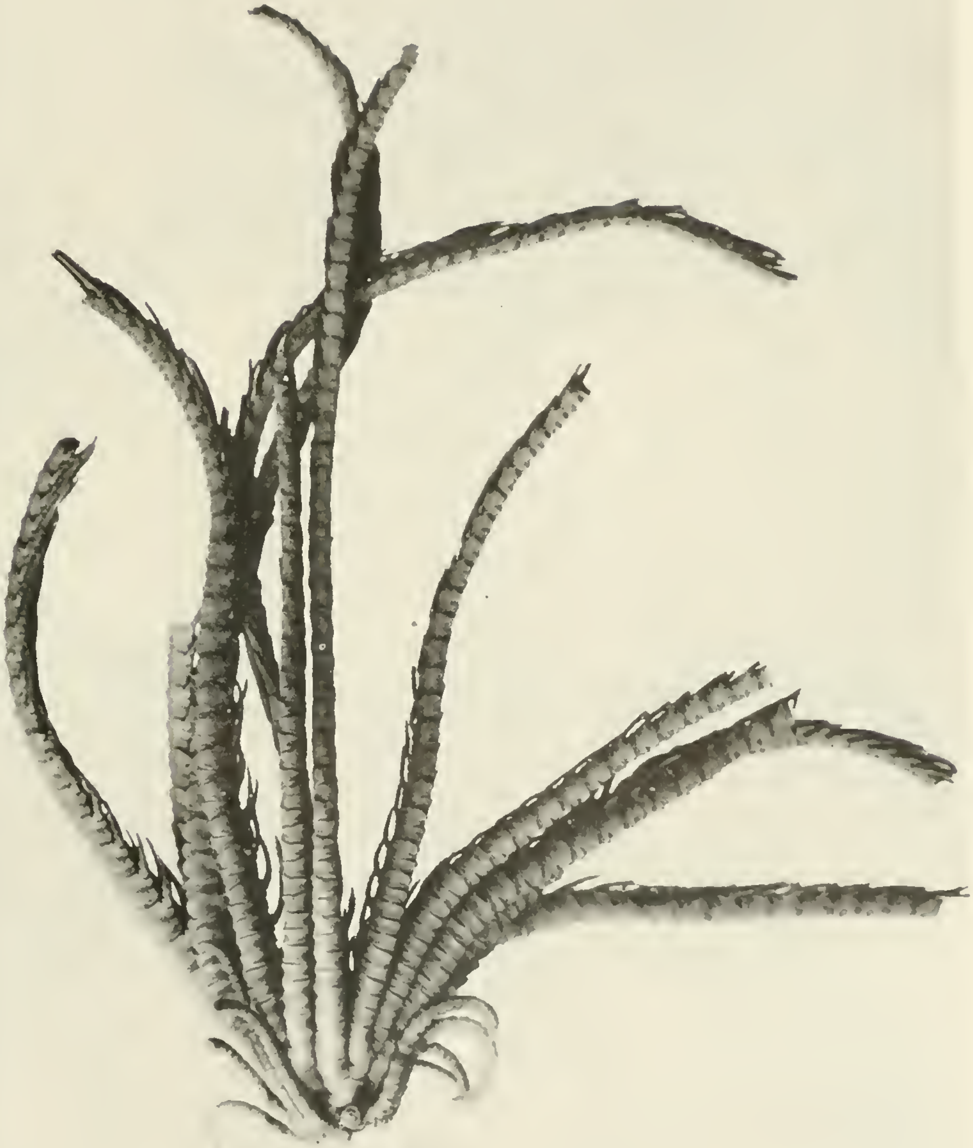

21


23


22

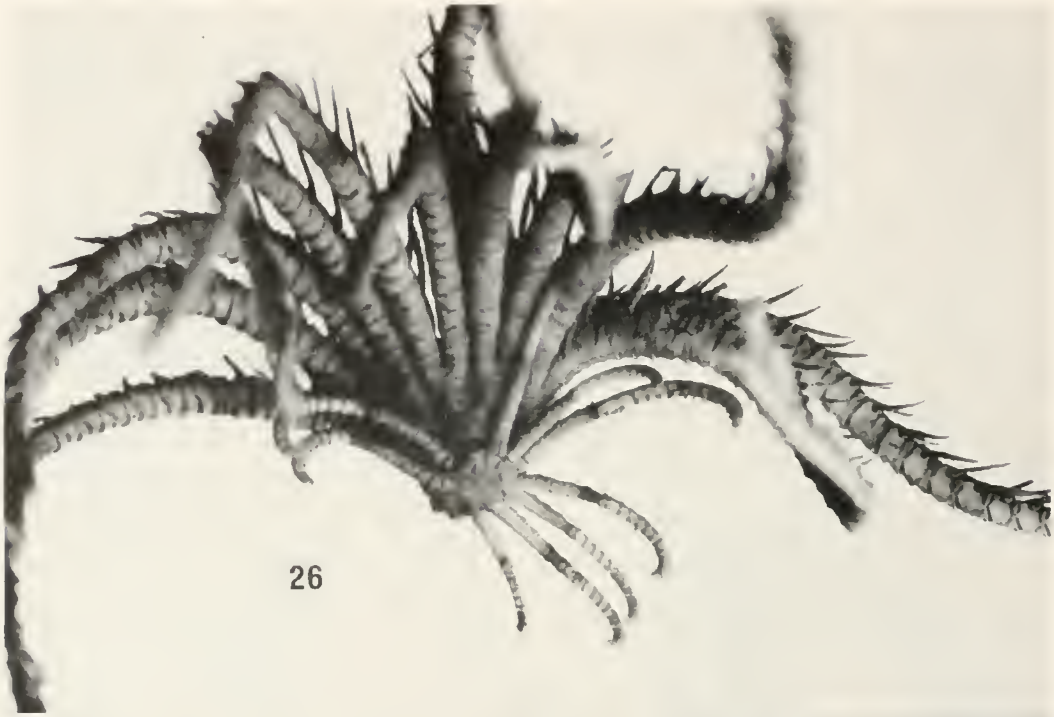

24

21, *Cosmiometra aster.* Type specimen from *Albatross* station 5088, × 2 (U.S.N.M., 22636).
22, *Cosmiometra philippinensis:* Specimen from *Albatross* station 5523 (U.S.N.M., 27497).
23, *Cosmiometra leilae:* Cotype from *Investigator* station 465, × 2 (I.M.).
24, *Horaeometra duplex:* Specimen from *Albatross* station 2346, × 2 (U.S.N.M., 22673).

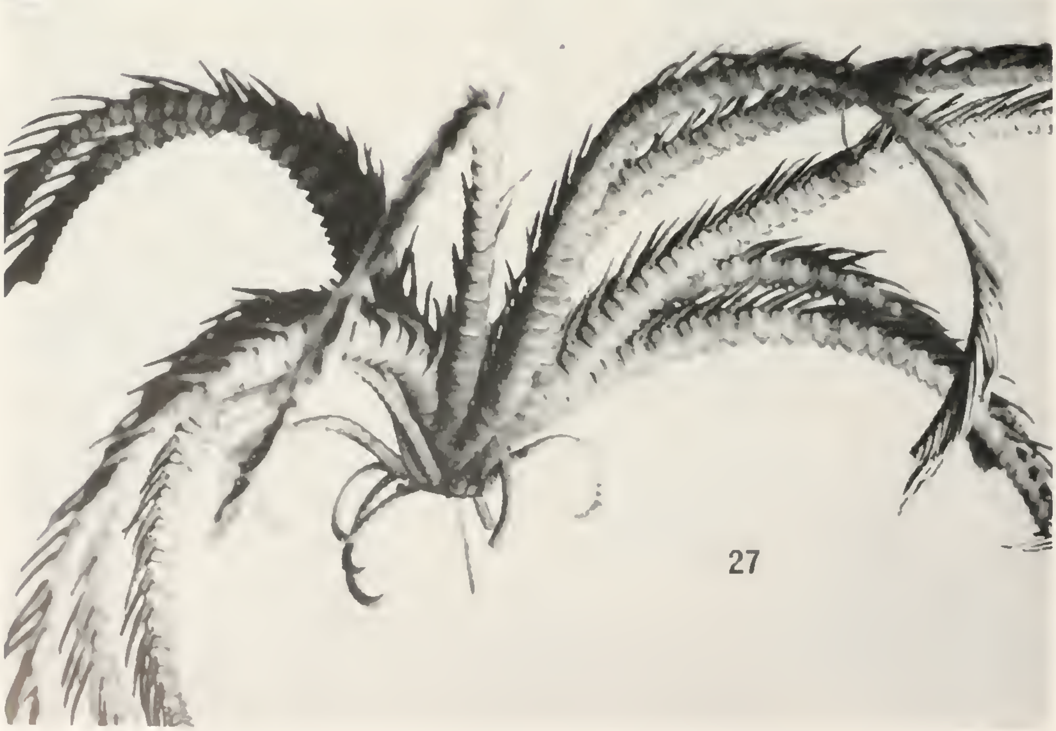


25

25, *Parametra granulata:* Specimen from *Albatross* station 5367, × 2 (U.S.N.M., 35601).



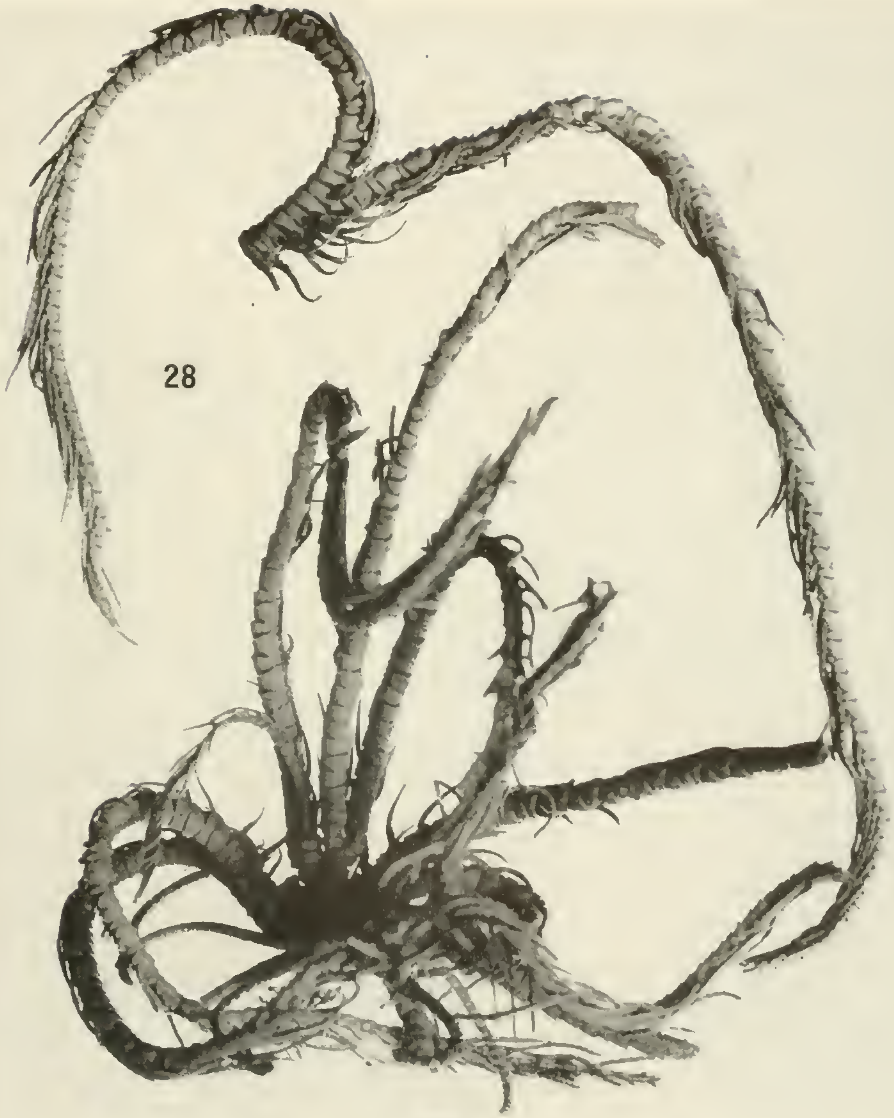
26



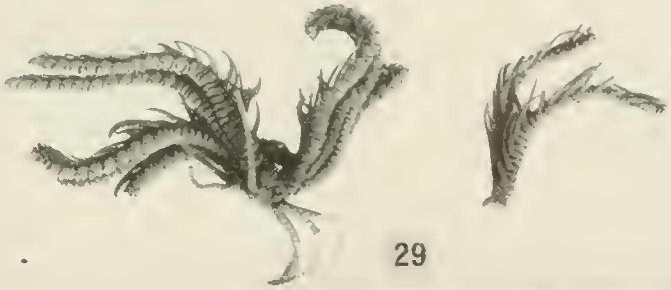
27

26, *Parametra compressa:* Specimen from *Albatross* station 5617, × 2 (U.S.N.M., 35976).

27, *Parametra orion:* Specimen from *Albatross* station 4934, × 2 (U.S.N.M., 35565). (Pinnules of this specimen shown on pl. 5, figs. 19, 20.)

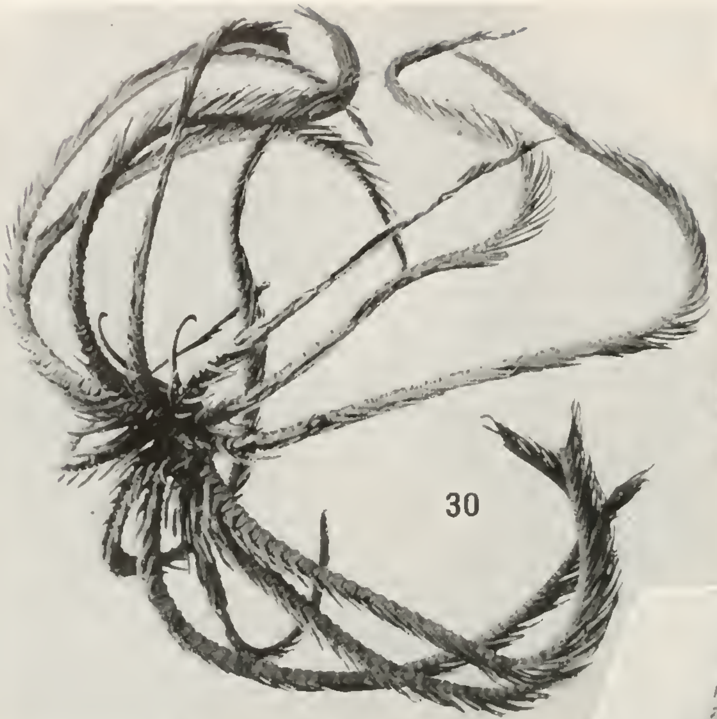


28

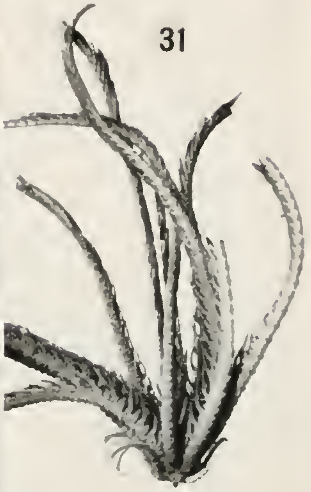


29

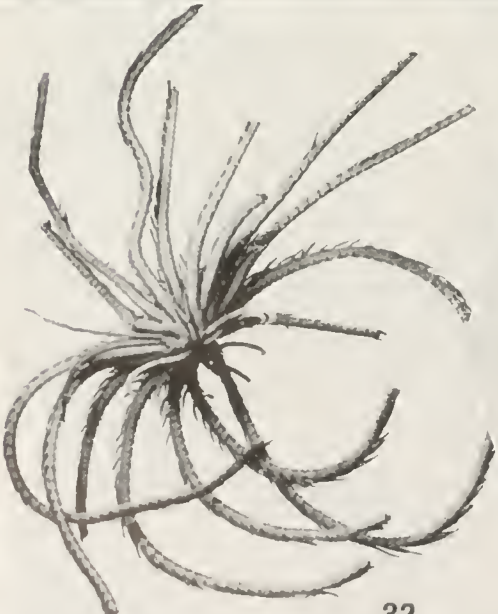
28, *Parametra fisheri:* Type specimen from *Albatross* station 4122, × 2 (U.S.N.M., 22686).
29, *Parametra ajax:* Type specimen from the Malay Archipelago (B.M.).



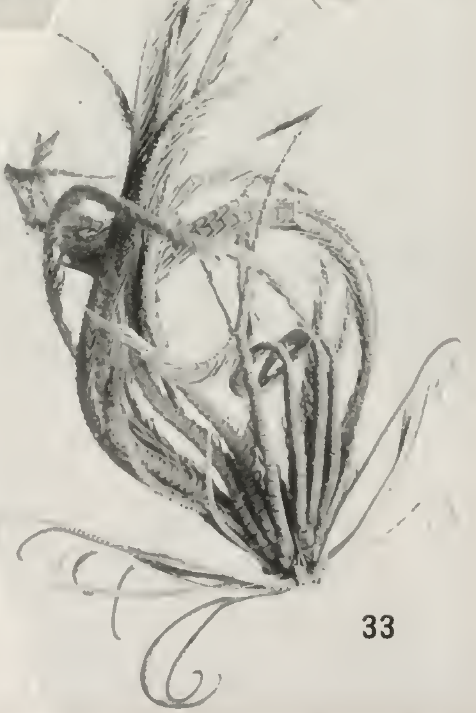
30



31

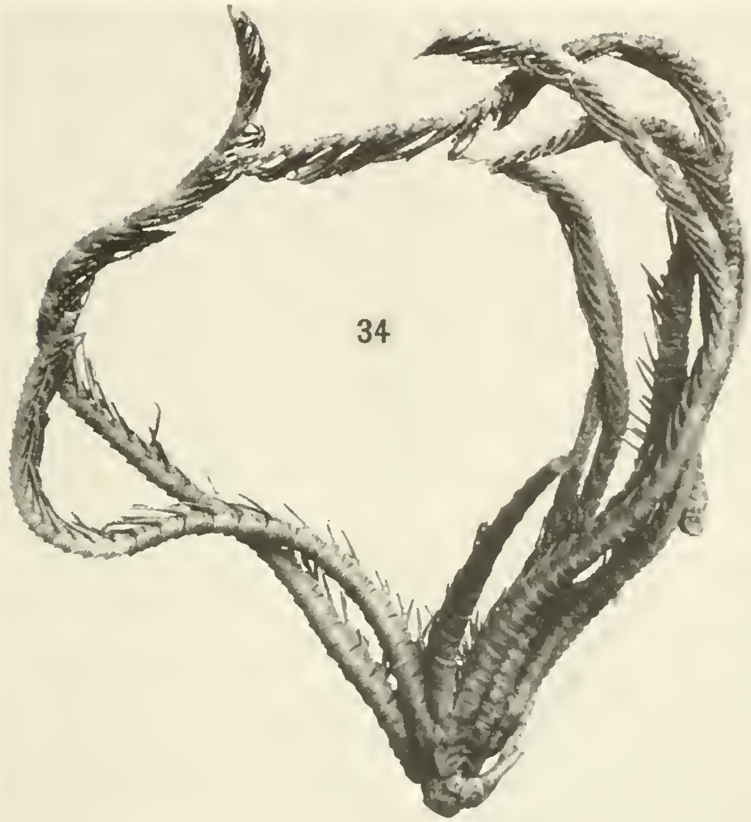


32

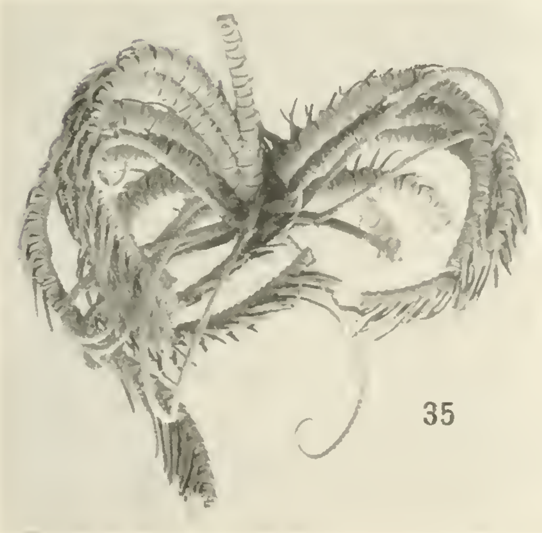


33

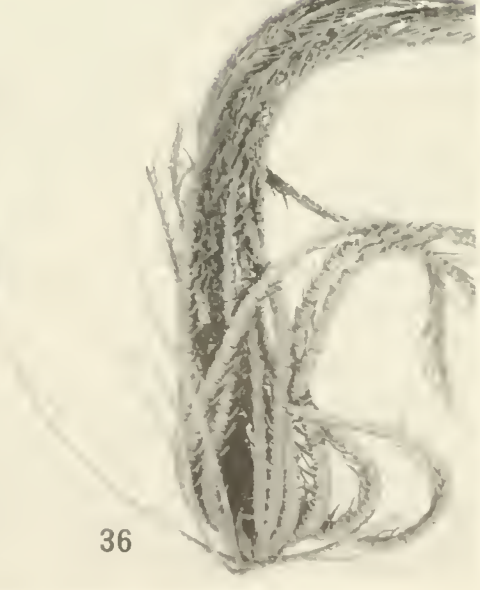
30. *Parametra orion:* Specimen from southern Japan.
31, 32. *Parametra granulata:* Specimens from *Albatross* station 5367 (U.S.N.M., 35601).
33. *Cosmiometra crassicirra:* Type specimen from *Albatross* station 3882 (U.S.N.M., 22689).



34

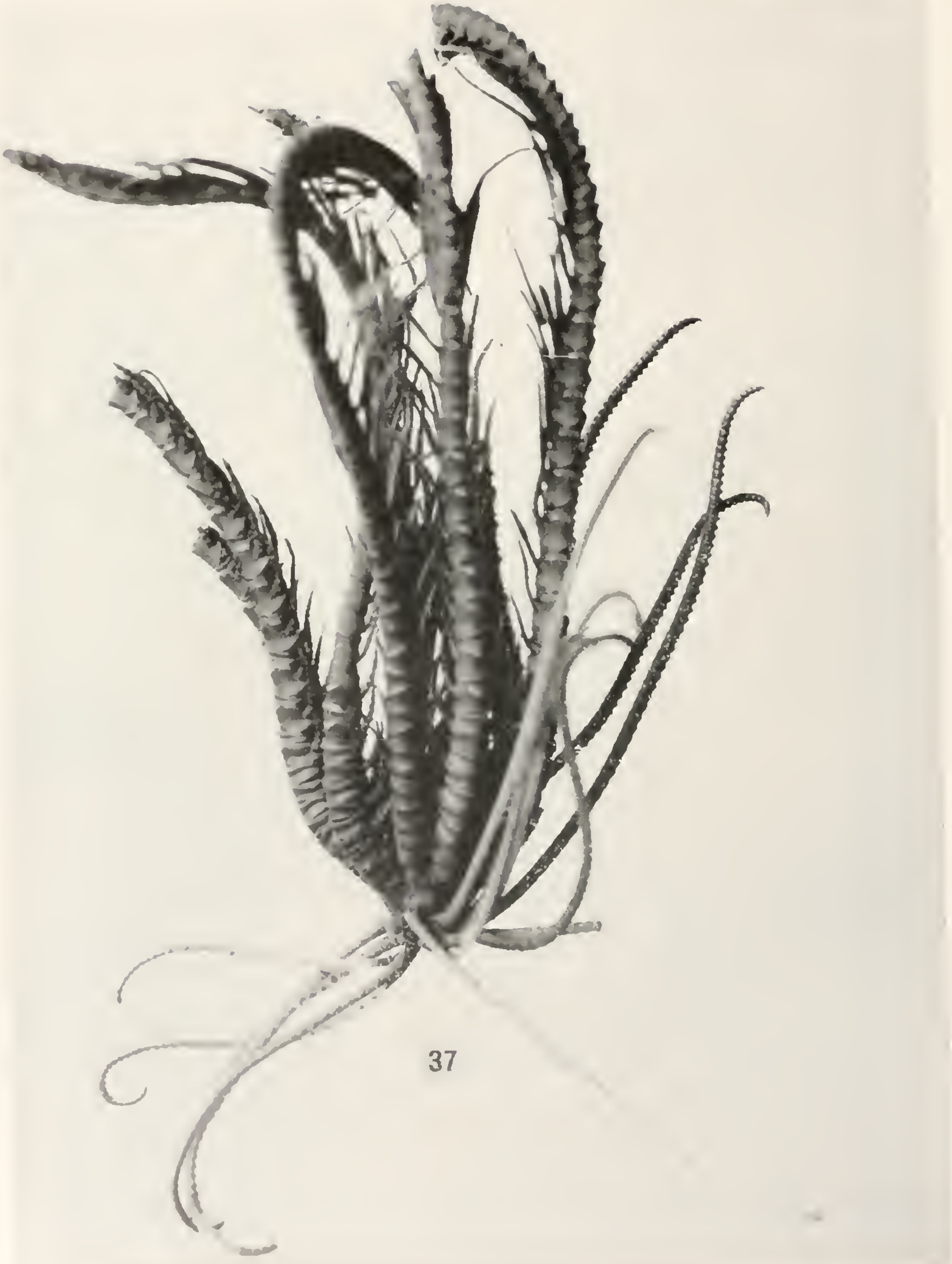


35

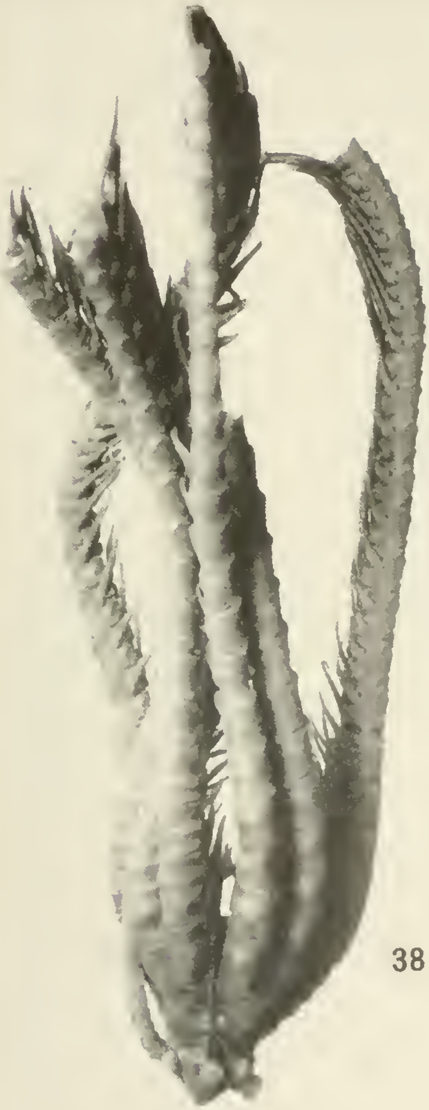


36

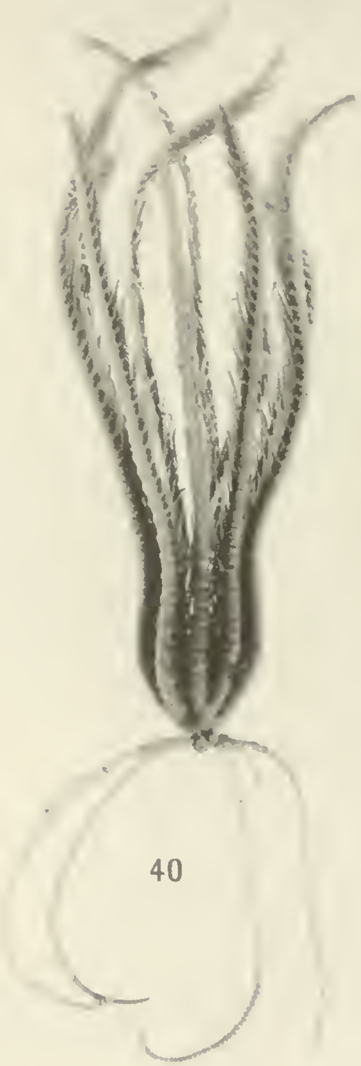
34. *Lissometra alboflava:* Type specimen from *Albatross* station 4936, × 2 (U.S.N.M., 22634).
35, 36. *Crotalometra rustica:* 35, Type specimen of *Crotalometra eridanella* from off Great Nicobar Island in 1,901–2,047 meters (B.M.); 35, specimen from off Madras in 1,097 meters (B.M.).



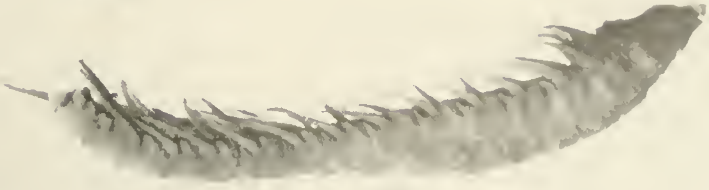
37, *Aglaometra propinqua:* Specimen from *Albatross* station 5424, × 2 (U.S.N.M., 35578).



38



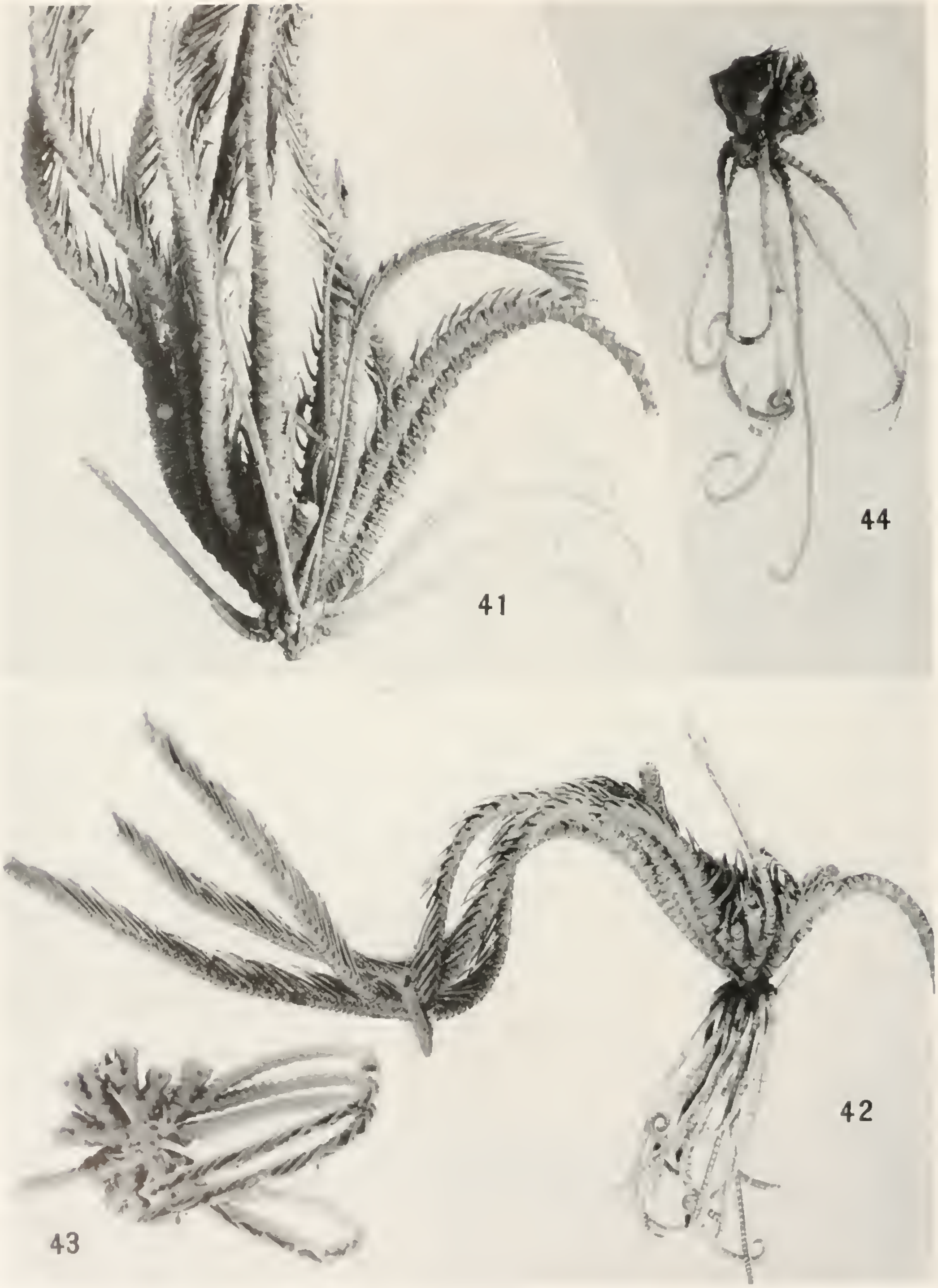
40



39

38, 39, *Aglaometra valida:* 38, Type specimen of *Crotalometra eupedata* from *Albatross* station 5236, × 2 (U.S.N.M., 25462); 39, lower and middle pinnules from the same specimen, × 2.

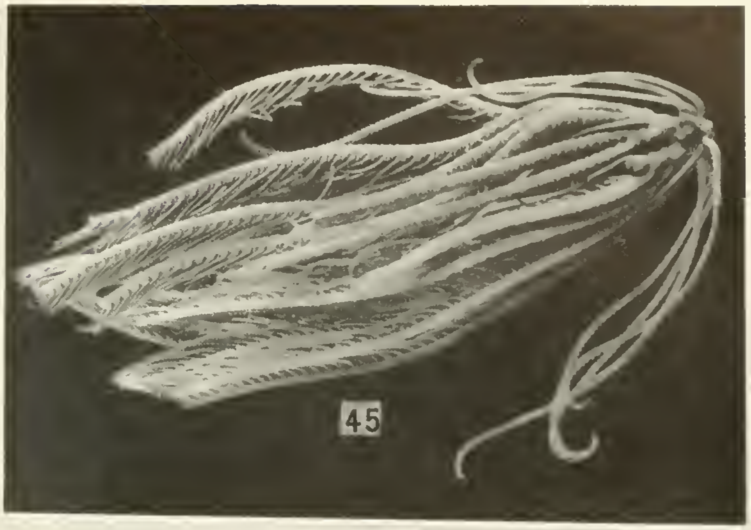
40, *Aglaometra sulcata:* Type specimen from *Siboga* station 161 (Amsterdam Mus.).



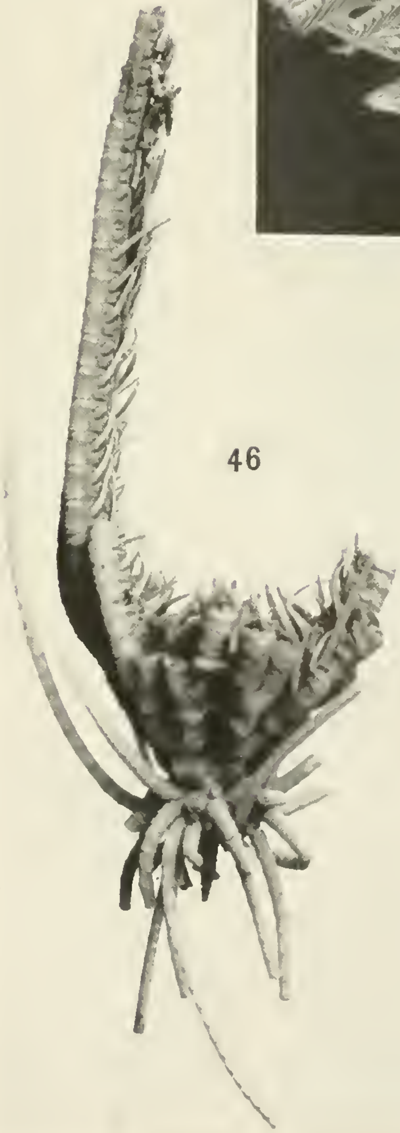
41, *Oceanometra gigantea:* Type specimen from *Albatross* station 3985 (U.S.N.M., 22687)

42, 43, *Oceanometra magna:* 42, Specimen from south of western Timor in 256-292 meters (B.M.); 43, type specimen from *Siboga* station 251 (Amsterdam Mus.).

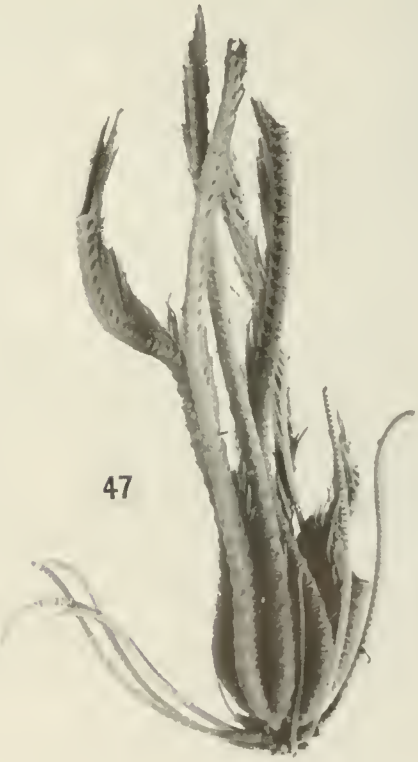
44, *Stiremetra perplexa:* Type specimen from *Siboga* station 211 (Amsterdam Mus.).



46

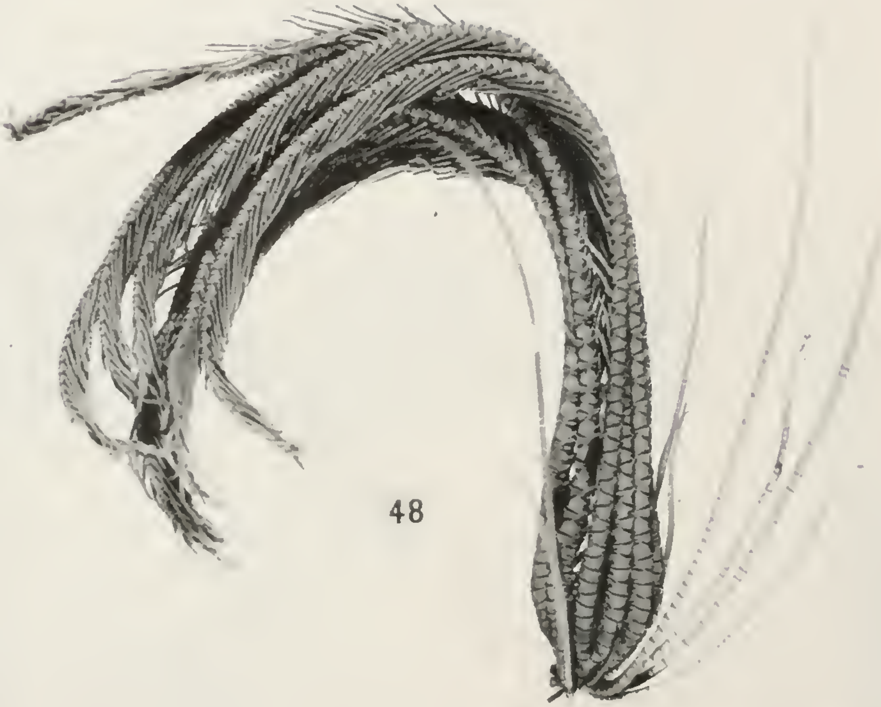


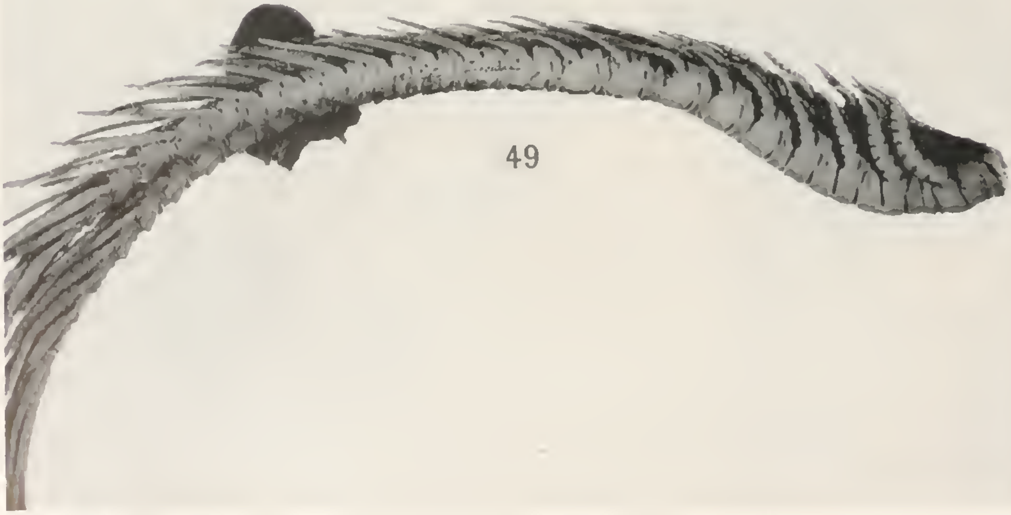
47



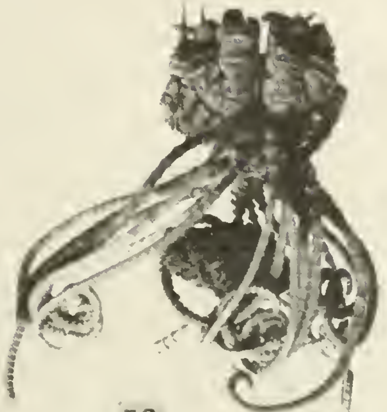
45, 46, *Oceanometra annandalei:* 45, Cotype from the Malay Archipelago in 55 meters. × 2 (U.S.N.M., 35577); 46, type specimen from the same locality (I.M.).

47, *Aglaometra propinqua:* Type specimen of *Aglaometra vera* from *Siboga* station 173 (Amsterdam Mus.).

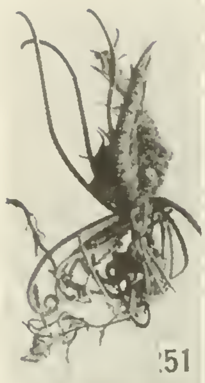

48


49

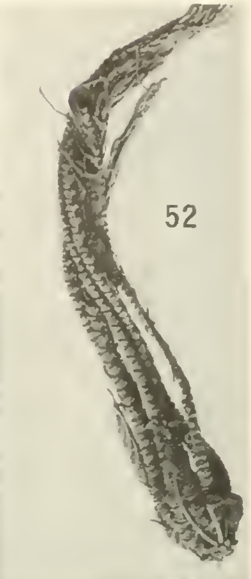
48, 49, *Ledametra necopinata:* 48, Type specimen from south of Lombok in 1,097 meters (B.M.); 49, pinnules of the same specimen.



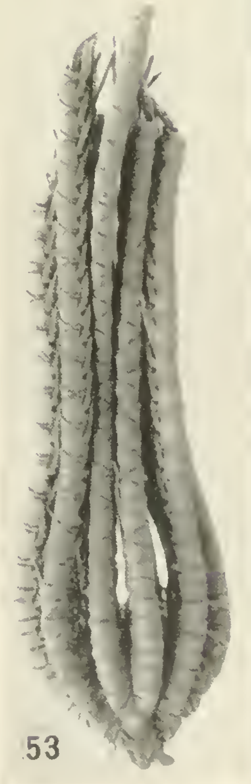
50



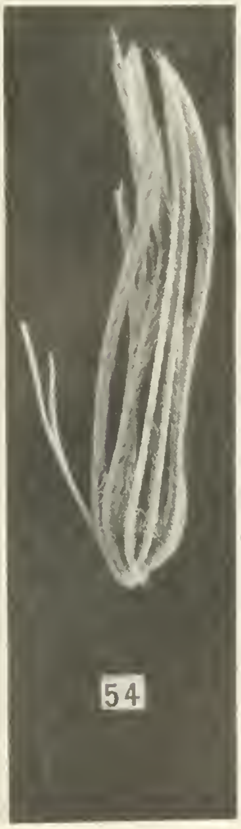
51



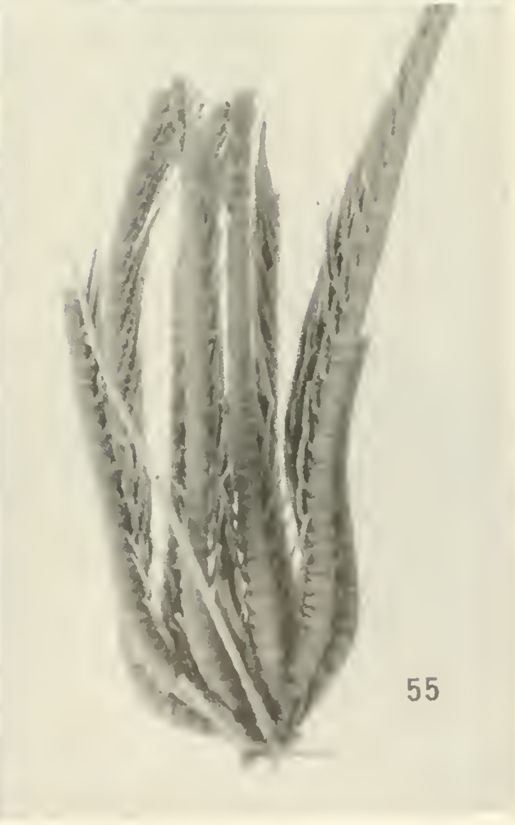
52



53



54

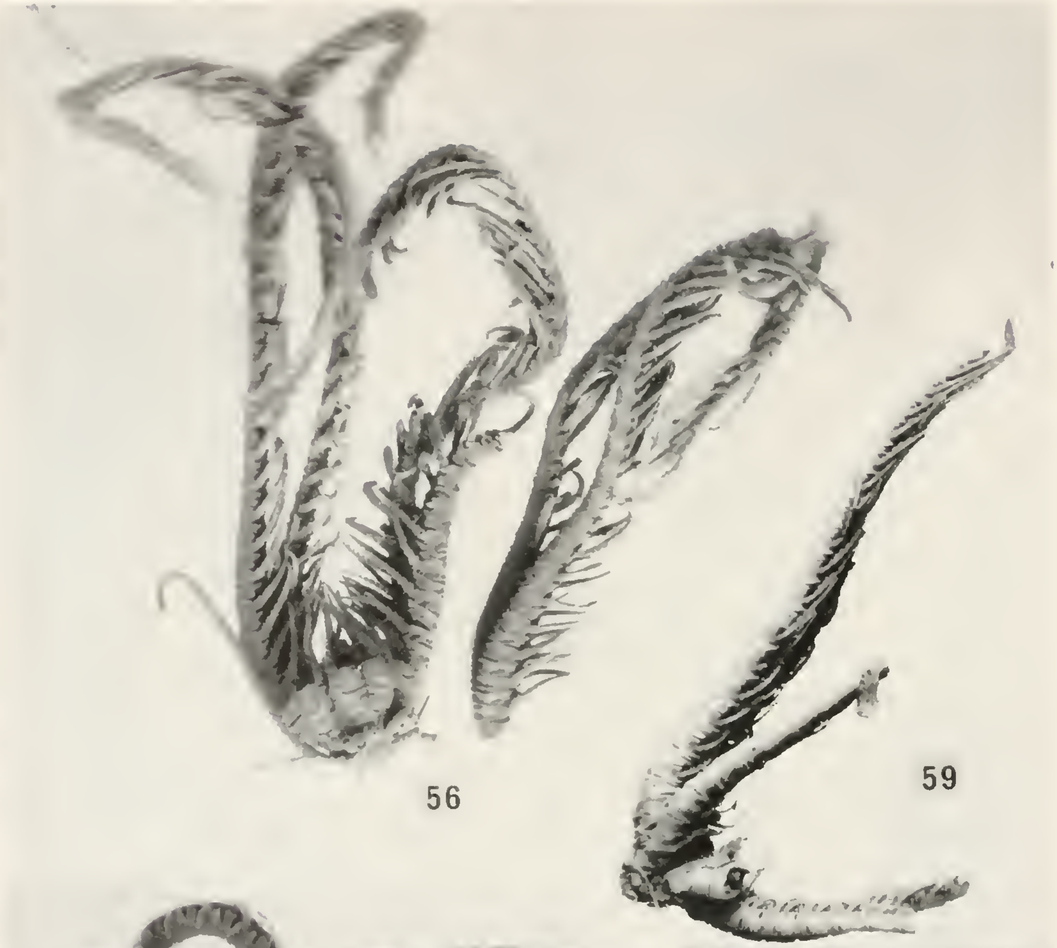


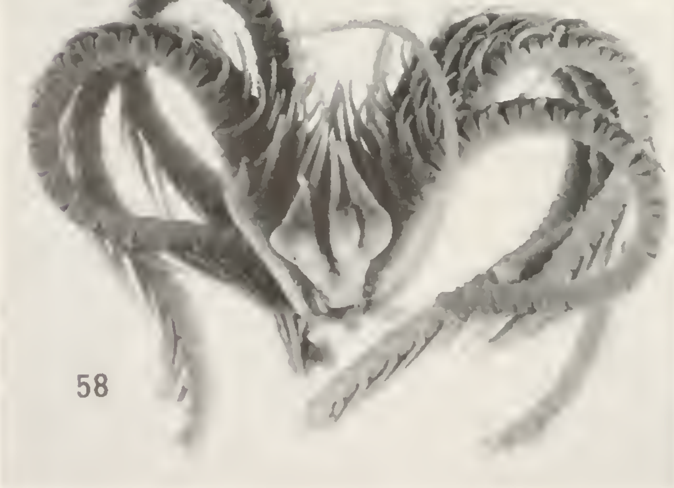
55

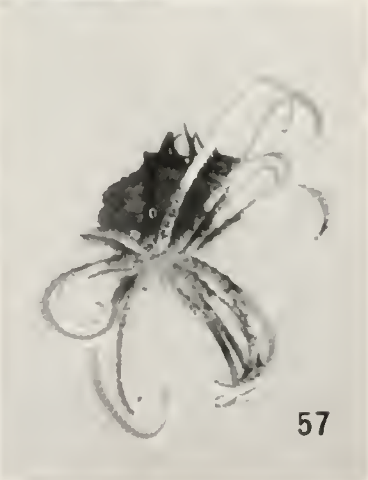
50–52, *Thalassometra villosa:* 50, Type specimen from *Albatross* station 4780, × 2 (U.S.N.M., 22630); 51, 52, cotypes from the same locality.

53, 54, *Thalassometra attenuata:* 53, Specimen from off Mozambique in 914 meters, × 2 (B.M.); 54, type specimen from south of Kurrachi in 1,398 meters (I.M.).

55, *Thalassometra margaritifera:* Type specimen from *Siboga* station 45 (Amsterdam Mus.).



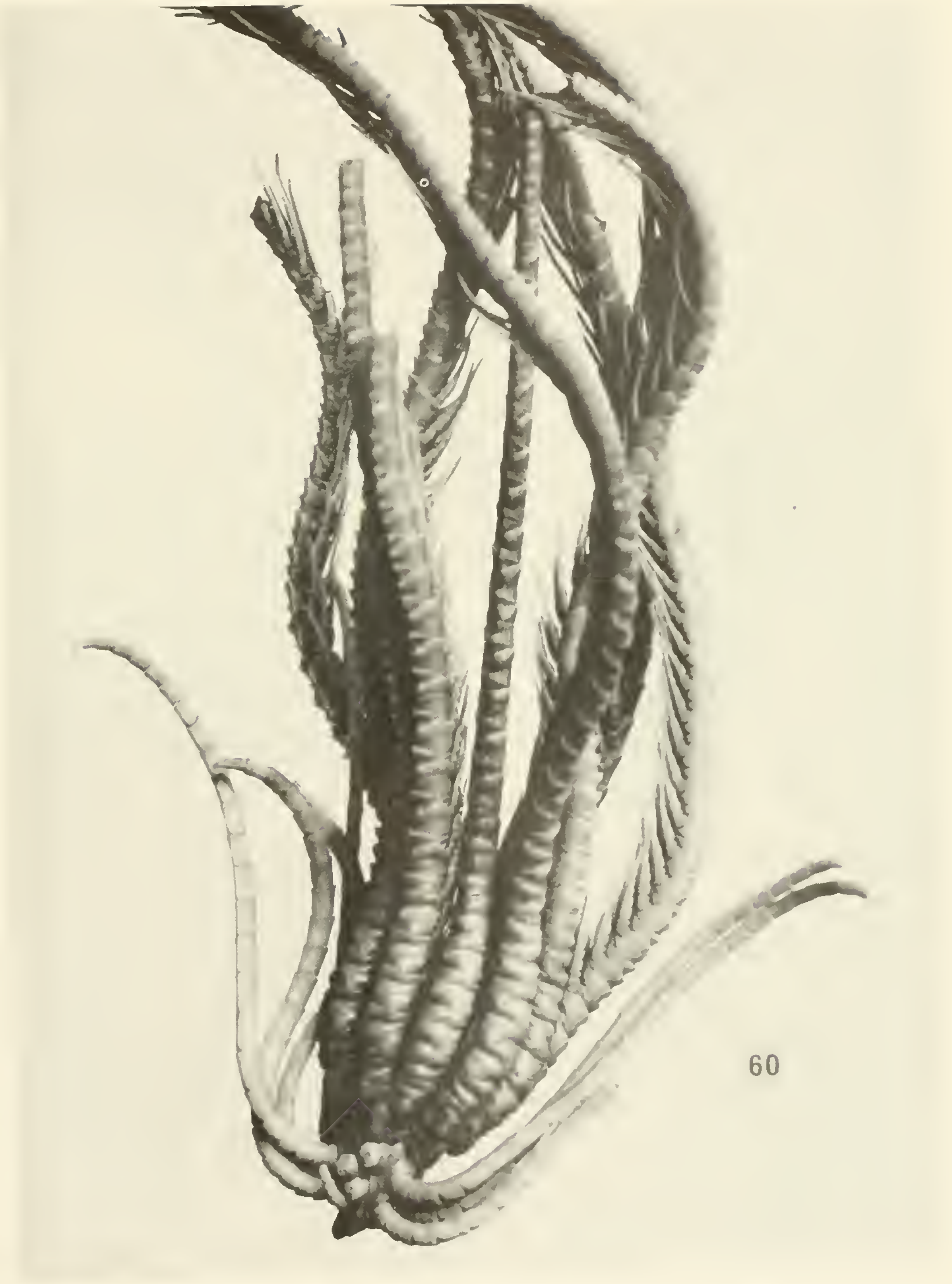




56, 57. *Thalassometra peripolos*: 56, Type specimen from south of the Nicobar Islands in 1,024 meters, × 2 (B.M.); 57, specimen from southeast of Car Nicobar (B.M.).

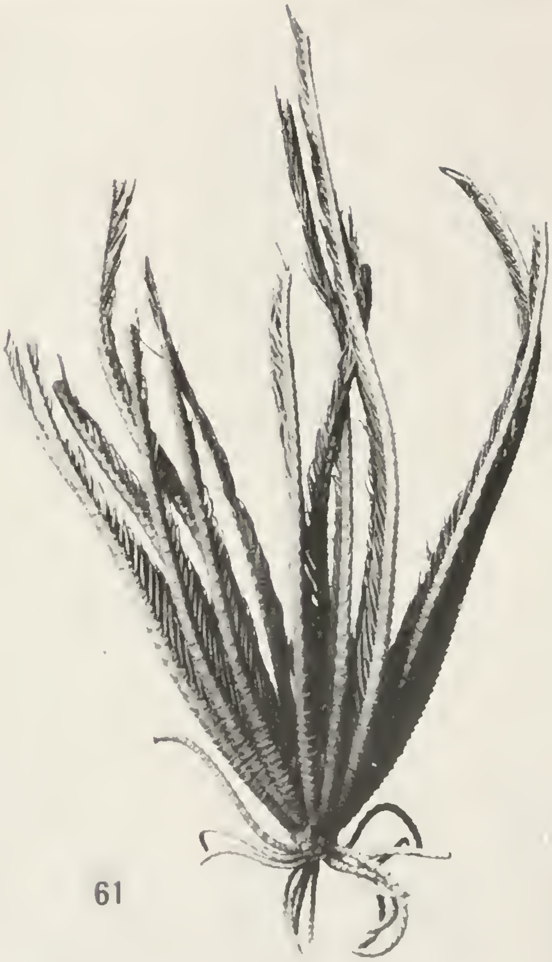
58. *Crotalometra rustica*: Type specimen of *Thalassometra marginalis* from *Siboga* station 226, × 2 (Amsterdam Mus.).

59. *Thalassometra hirsuta*: Type specimen from *Albatross* station 5445, × 2 (U.S.N.M., 27500).

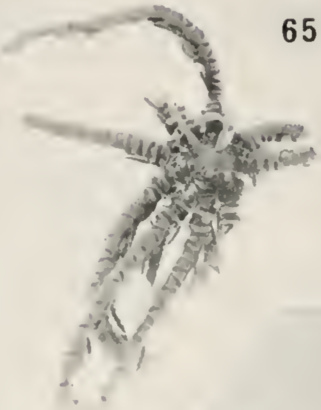


60

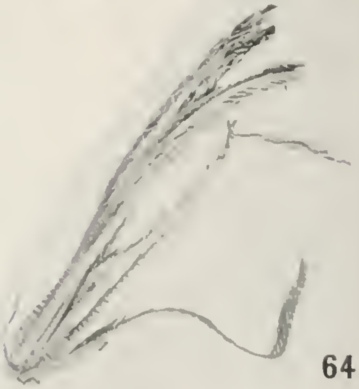
60, *Chondrometra robusta:* Specimen from *Siboga* station 297. × 2 (U.S.N.M., E. 464).



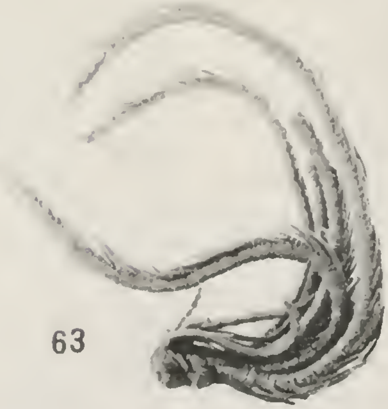
61



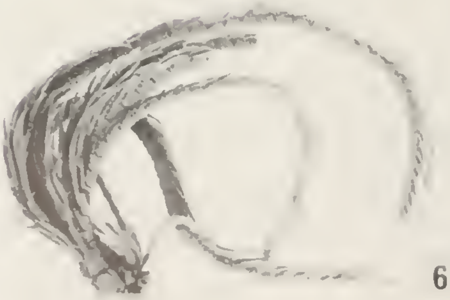
65



64

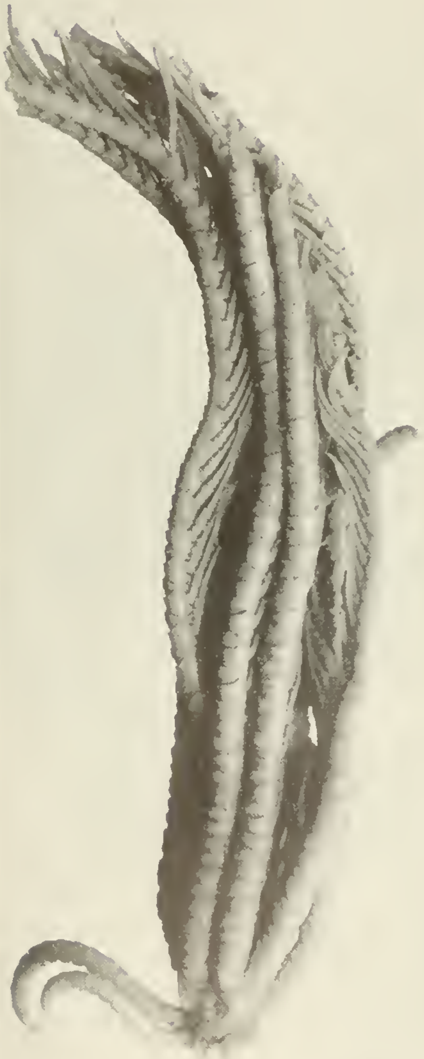


63

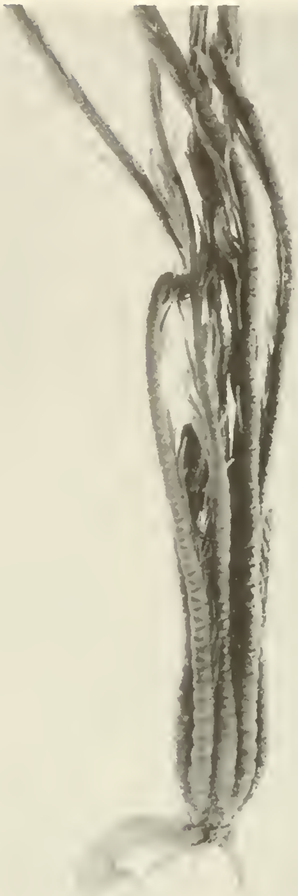


62

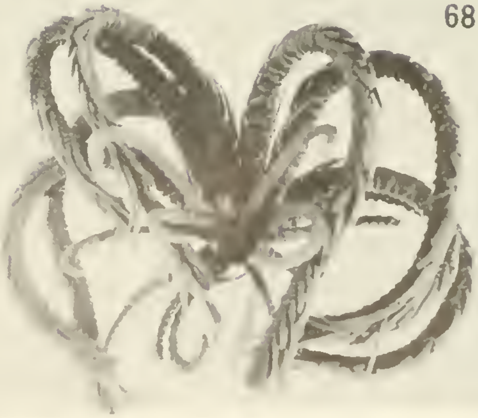
61. *Monachometra patula.* Specimen from *Albatross* station 5356 (U.S.N.M., 35704).
62, 63. *Monachometra fragilis:* Type specimen from *Siboga* station 166 (Amsterdam Mus.).
64. *Chlorometra garrettiana:* Type specimen from *Albatross* station 4894 (U.S.N.M., 22633).
65, *Strotometra ornatissimus:* Type specimen from *Siboga* station 122. × 2 (Amsterdam Mus.).



66



67

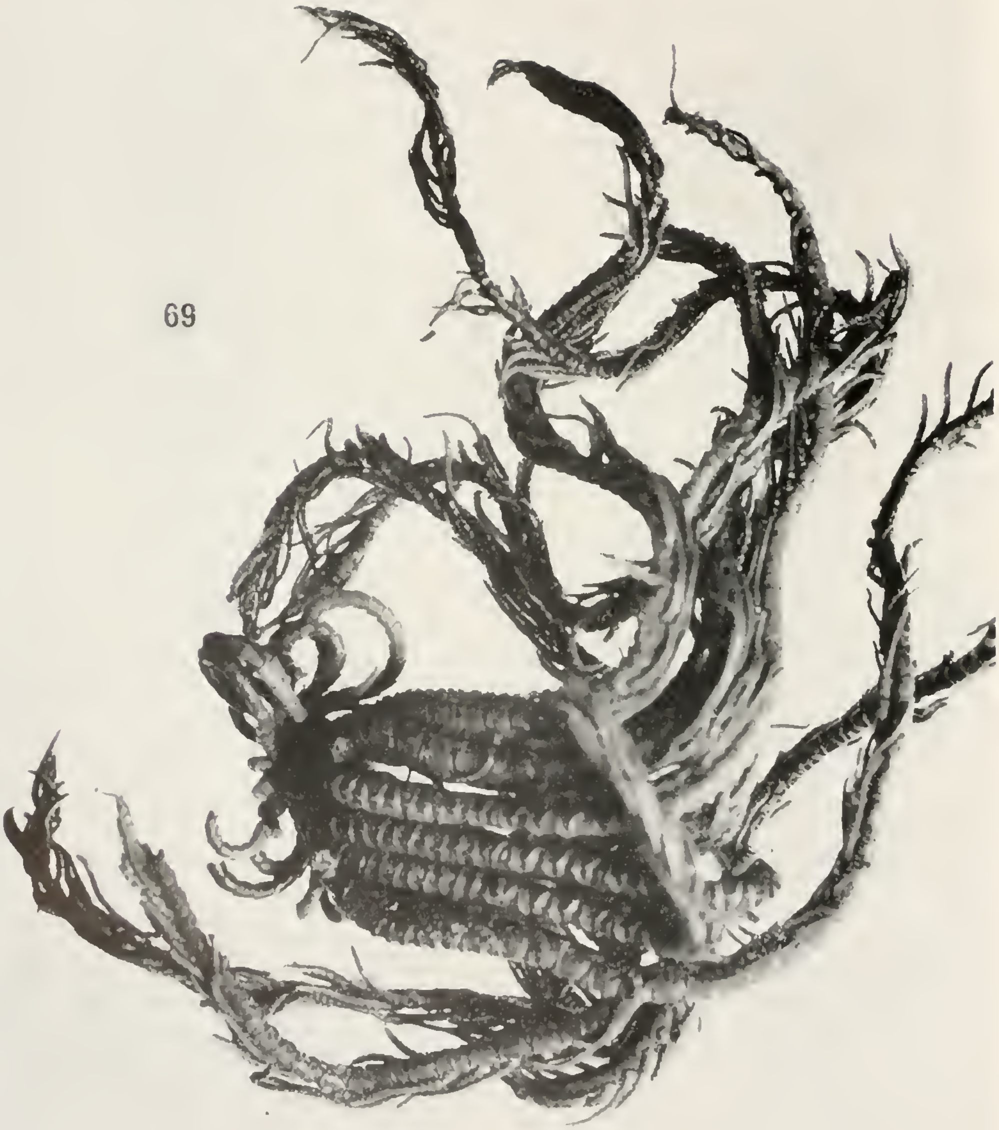


68

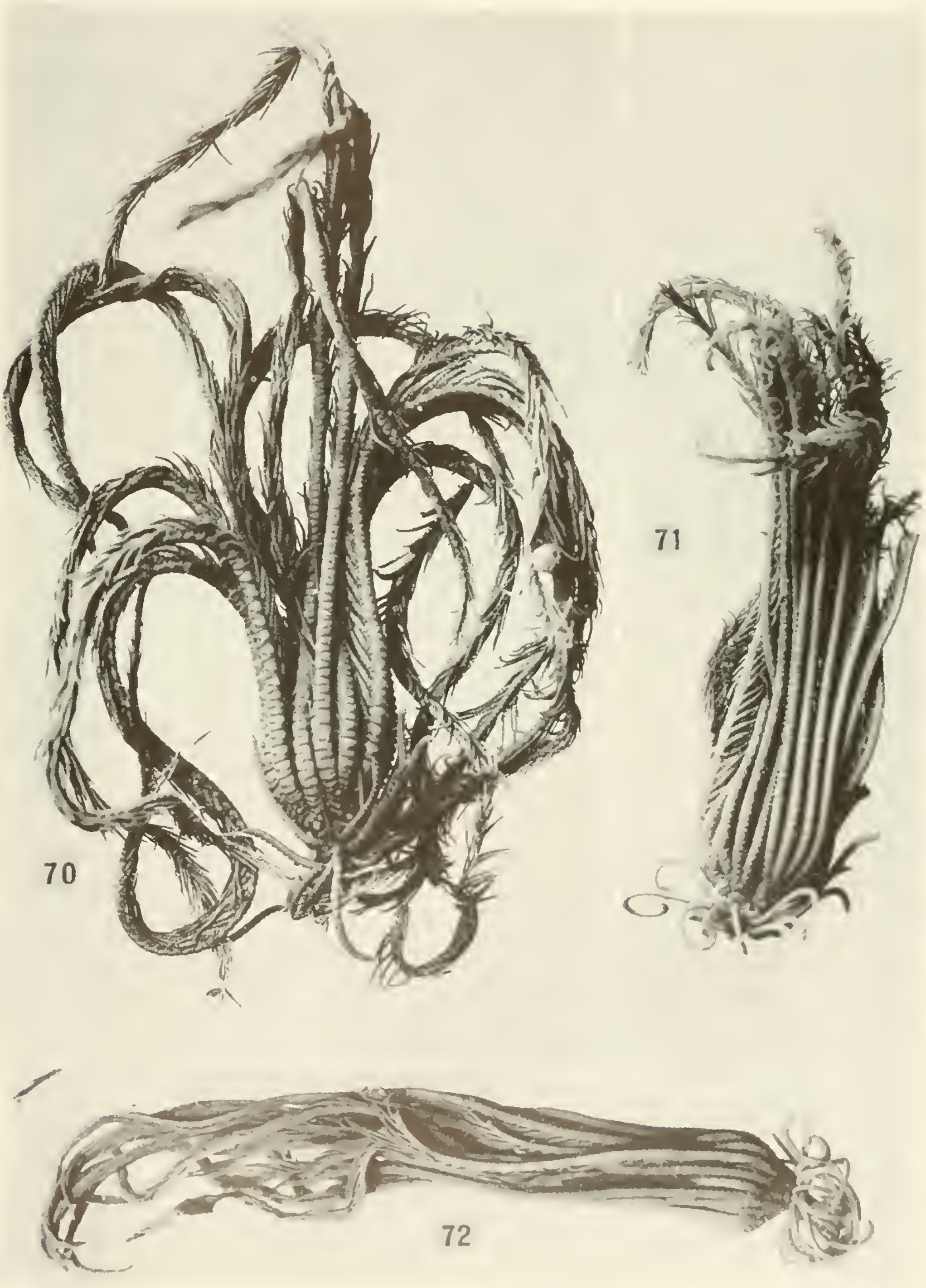
66, 67, *Glyptometra timorensis:* 66, Cotype from *Siboga* station 297, × 2 (U.S.N.M., E. 424); 67, type specimen from *Siboga* station 297 (Amsterdam Mus.).

68, *Glyptometra crassa:* Type specimen from *Siboga* station 259 (Amsterdam Mus.).

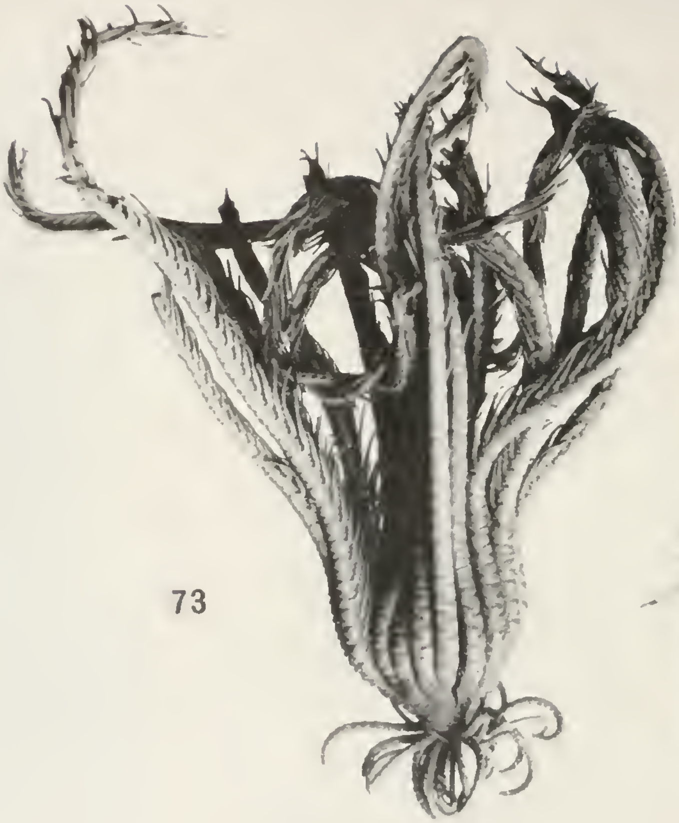
69



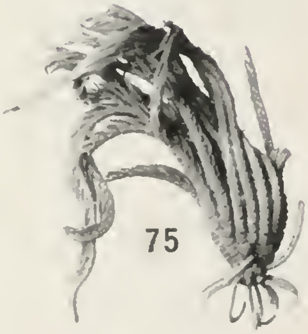
69, *Glyptometra tuberosa:* Specimen from *Albatross* station 5367, × 2 (U.S.N.M. 35668).



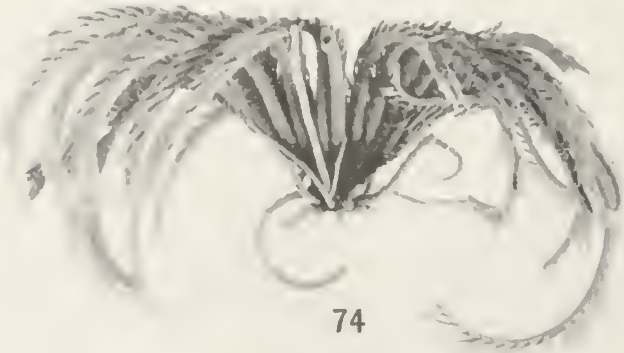
70–72, *Glyptometra distincta:* 70, Type specimen of *Pachylometra selene* from *Albatross* station 5523 (U.S.N.M., 27504); 71, specimen from the Danish Expedition to the Kei Islands (C.M.); 72, type specimen of *Charitometra smithi* from *Albatross* station 5123 (U.S.N.M., 25448).



73



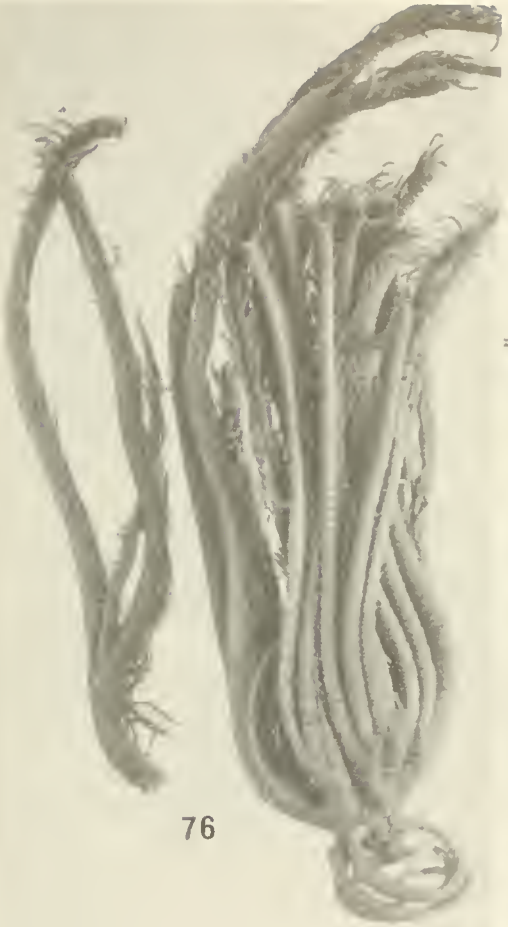
75



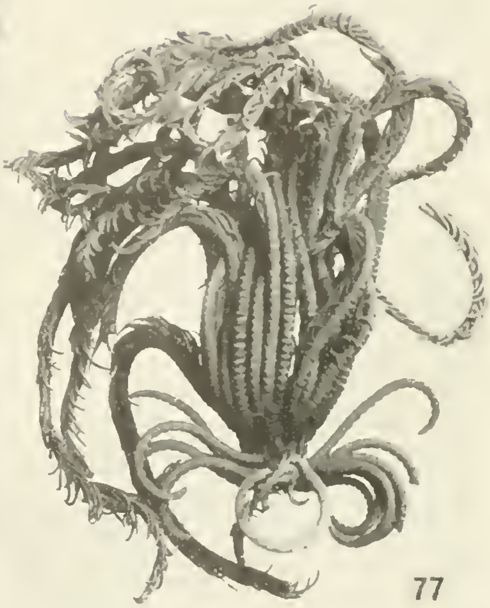
74

73, *Gyptometra distincta.* Specimen from *Albatross* station 5523 (U.S.N.M., 36001).

74, 75, *Gyptometra investigatoris:* 74, Specimen from *Siboga* station 254 (Amsterdam Mus.); 75, specimen from *Siboga* station 297 (Amsterdam Mus.).

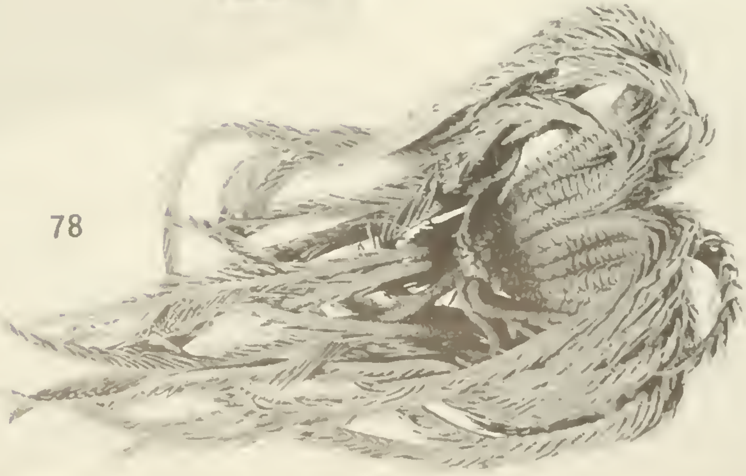


76



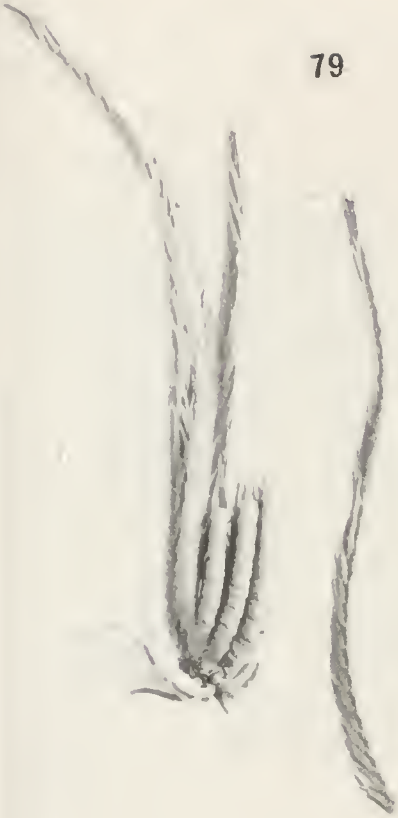
77

78

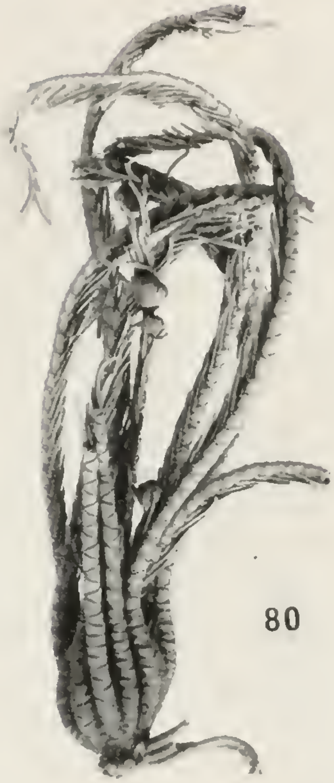


76–78, *Glyptometra investigatoris:* 76, Type specimen from the Malay Archipelago in 55 meters (I.M.); 77, specimen from *Albatross* station 5325 (U.S.N.M., 27503); 78, specimen from the Bali Sea in about 200 meters (Buitenzorg, Java, Mus.).

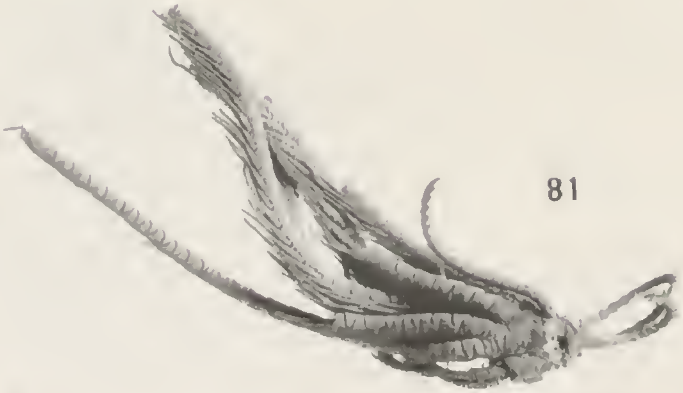
79



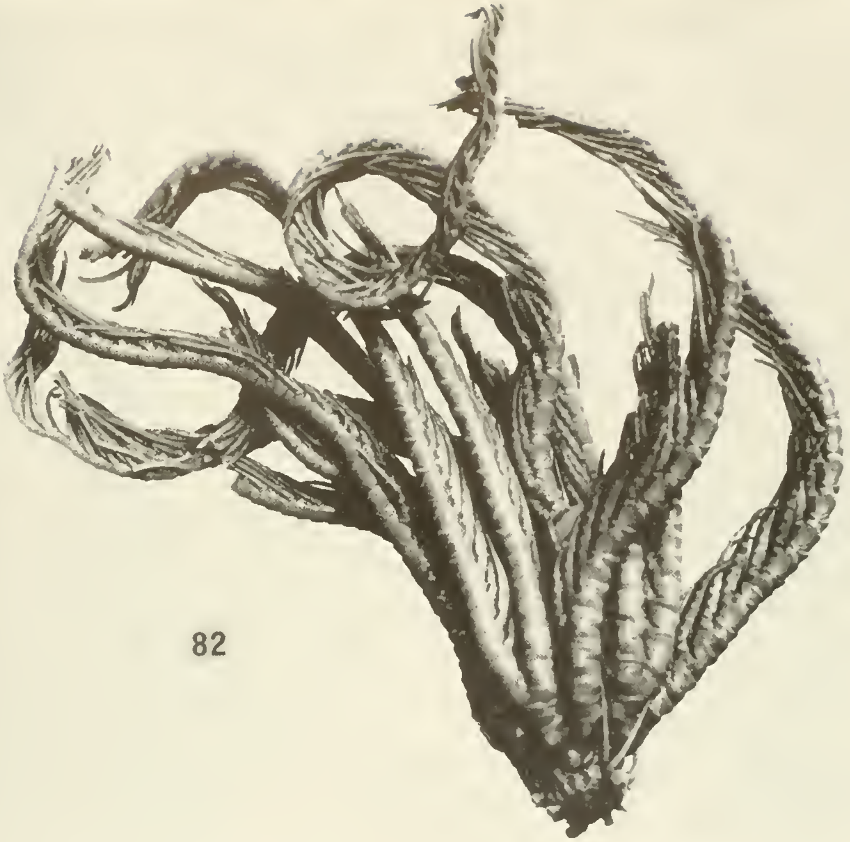
80



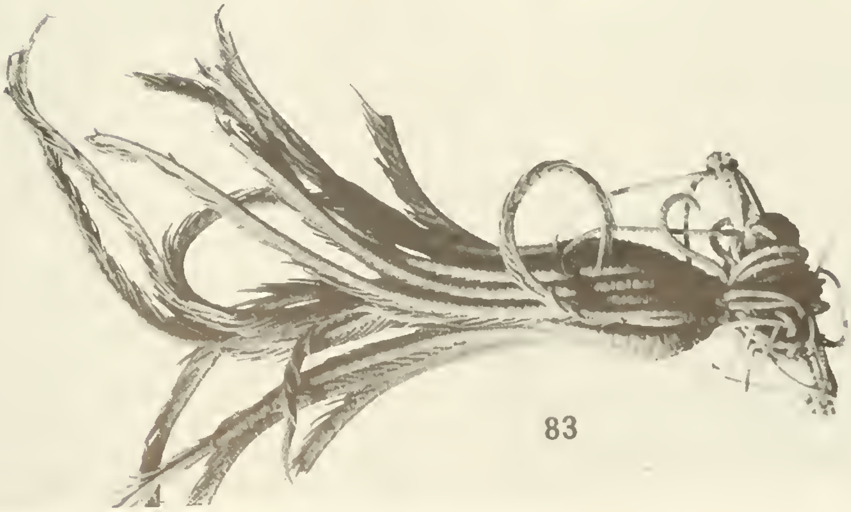
81



79–81, *Glyptometra macilenta.* 79, Type specimen from the Laccadive Islands in 1,288 meters (I.M.); 80, specimen from south of Timorlaut in 914 meters (B.M.); 81, type specimen of *Perissometra occidentalis* from off the Seychelles in 1,462 meters (B.M.).

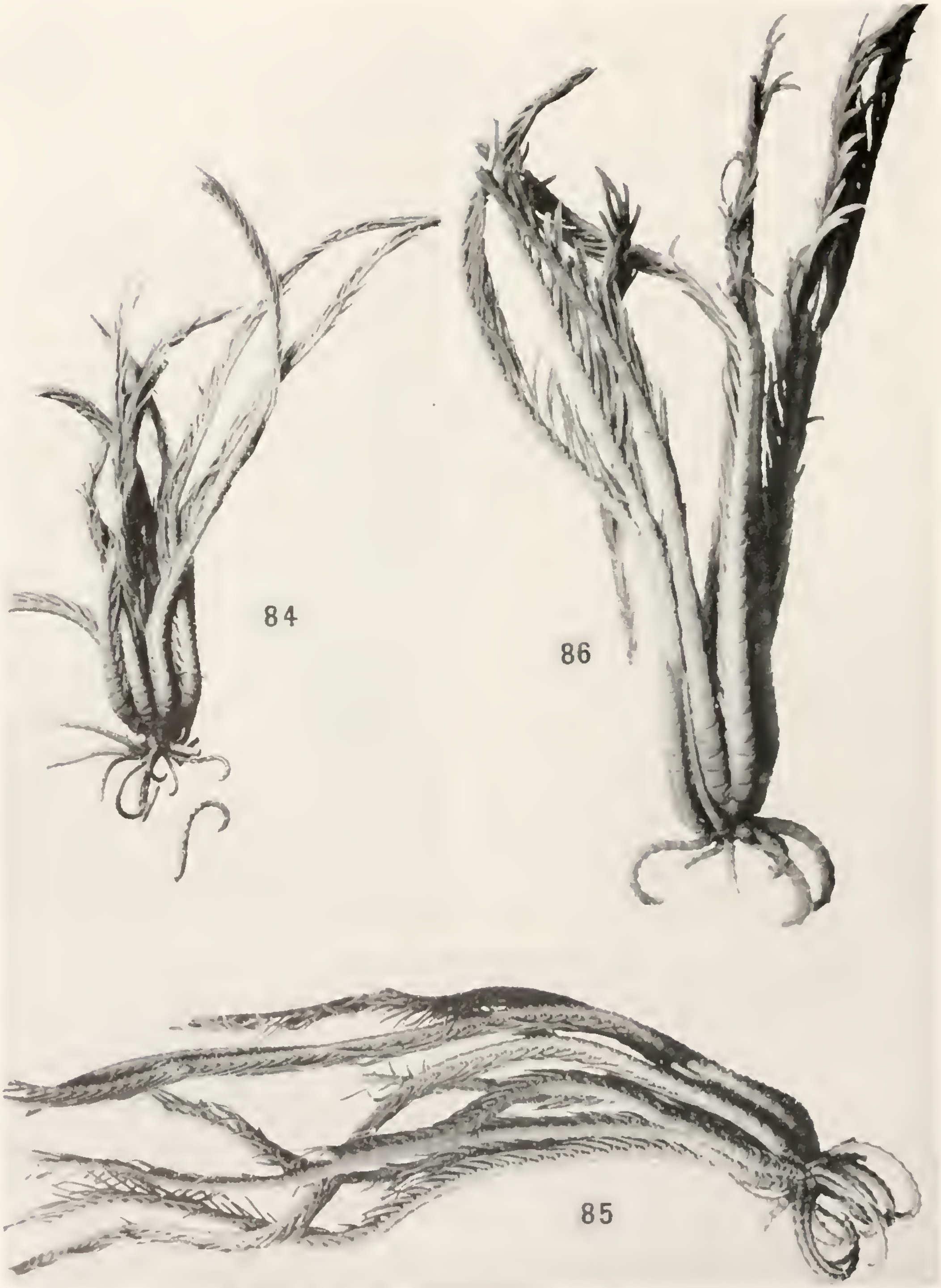


82

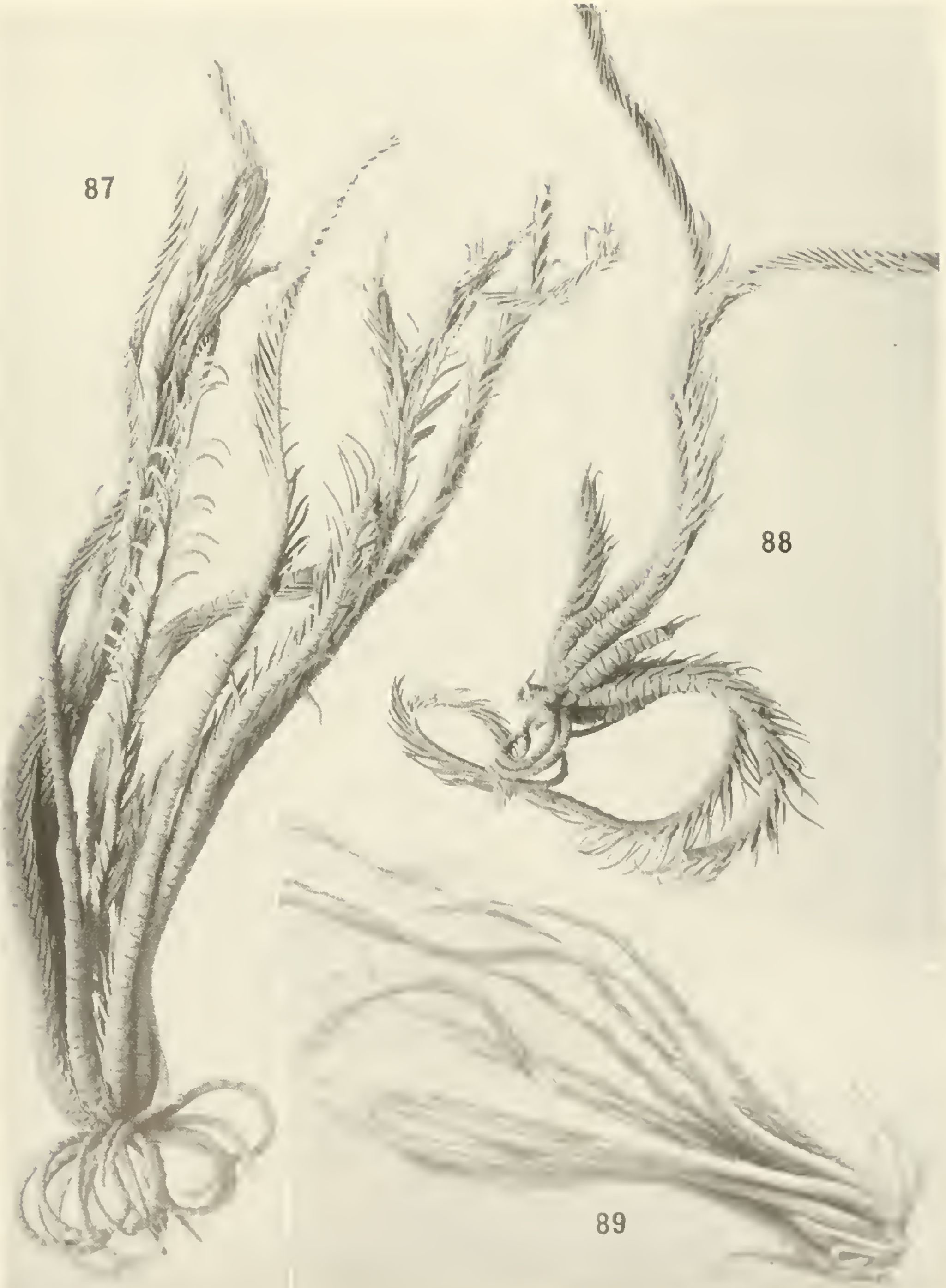


83

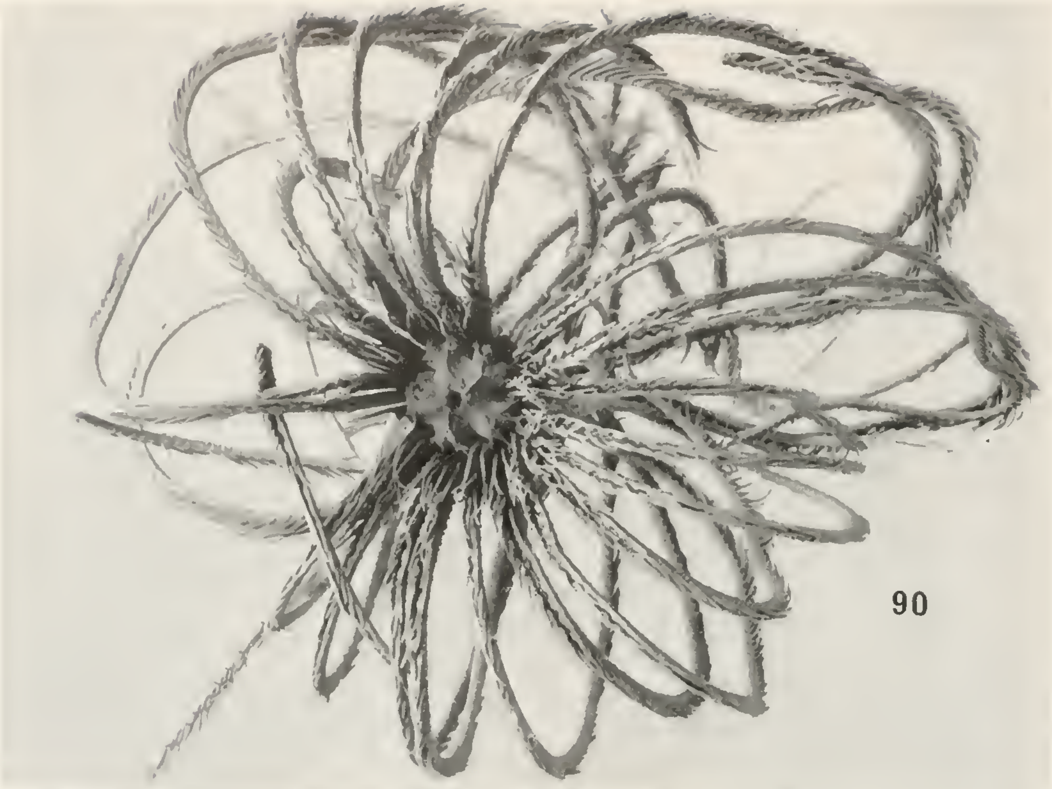
82, 83, *Glyptometra levigata:* 82, Type specimen from *Albatross* station 5236, × 2 (U.S.N.M., 25464); 83, specimen from *Albatross* station 5367 (U.S.N.M., 35896).



84–86, *Glyptometra lata.* 84, Specimen from off Misaki, Japan (U.S.N.M., 35684); 85, Type specimen from *Albatross* station 4918 (U.S.N.M., 22628); 86, Specimen from *Albatross* station 4918, No. 2 (U.S.N.M., 22628).

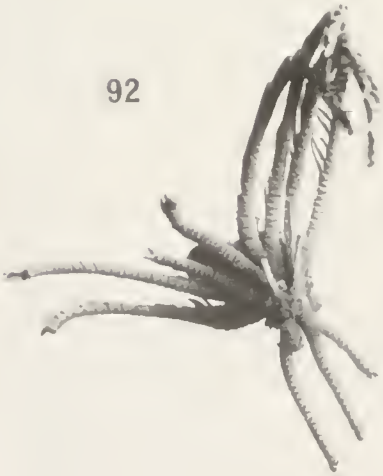


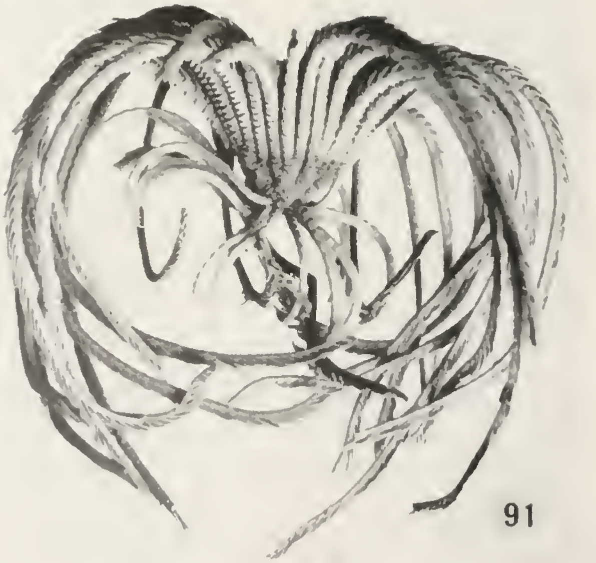
87, *Glyptometra lateralis* (U.S.N.M.).
88, *Glyptometra lata:* Cotype from *Albatross* station 4918 (U.S.N.M., 22628).
89, *Glyptometra invenusta:* Type specimen from off South Andaman Island in 1,040 meters (I.M.).



90

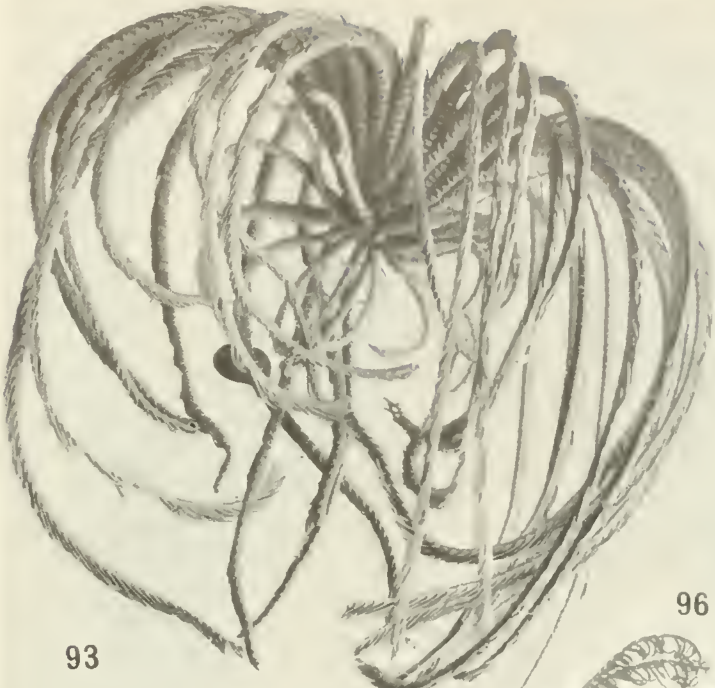
92



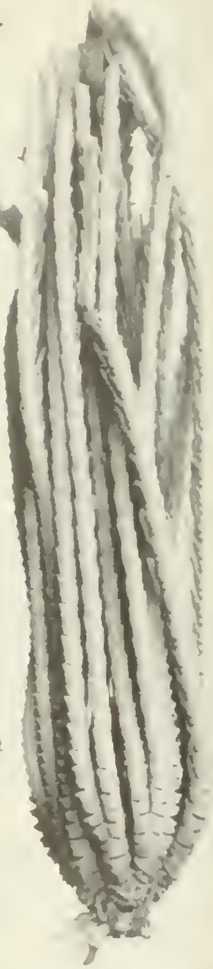


91

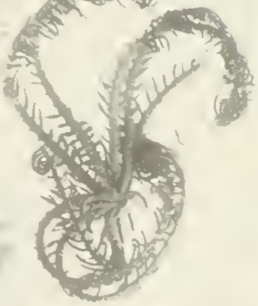
90. *Crinometra brevipinna* (U.S.N.M.).
91. *Crinometra brevipinna* var. *pulchra:* Type specimen from *Albatross* stations 2319–2350 (U.S.N.M., 25473).
92. *Crinometra brevipinna* var. *gemmata:* Type specimen from *Albatross* station 2330 (U.S.N.M., 25474).



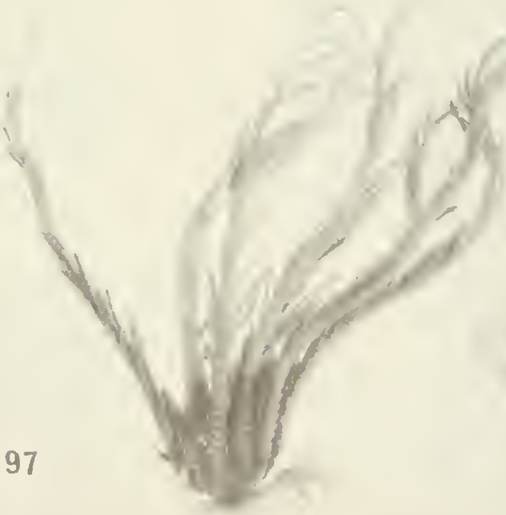
93



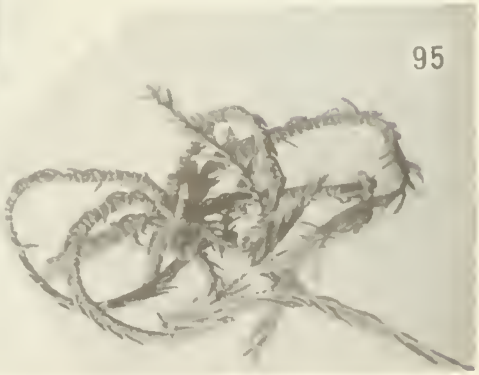
94



96



97



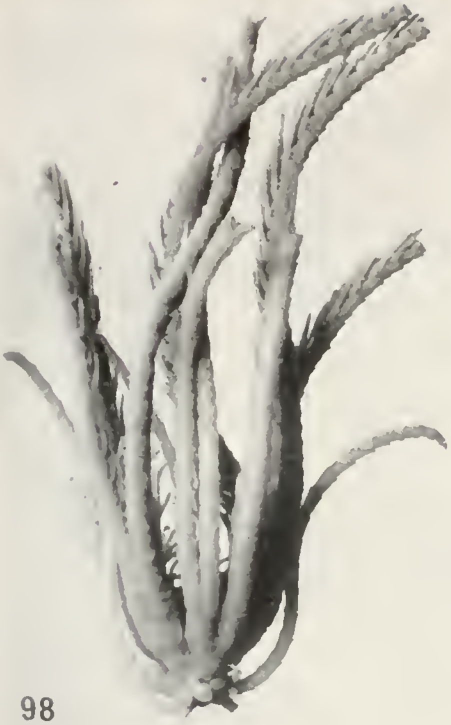
95

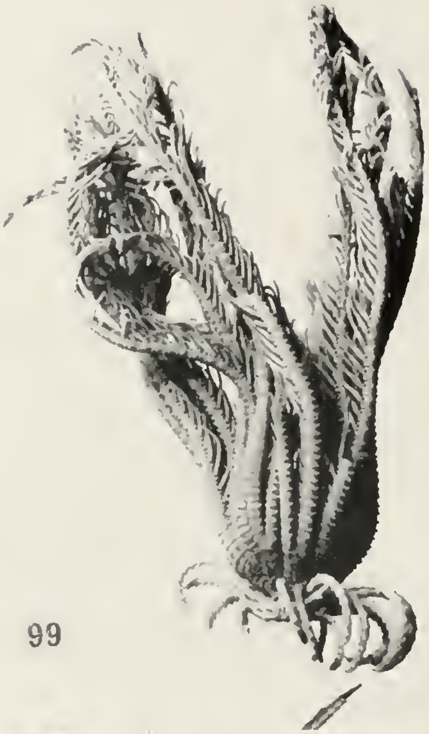
93. *Crinometra brevipinna.* Specimen shown on plate 30, figure 90 (U.S.N.M.).

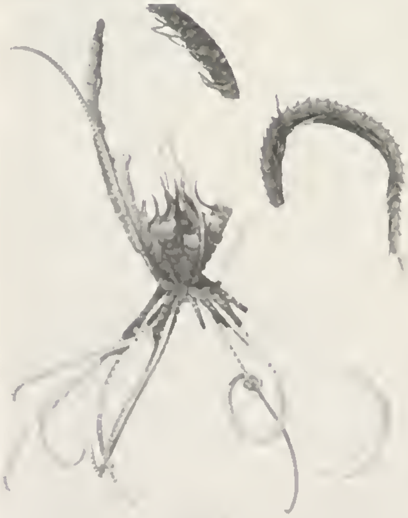
94, *Crinometra brevipinna* var. *margaritacea:* Specimen from *Albatross* station 2156, × 2 (U.S.N.M., 16898).

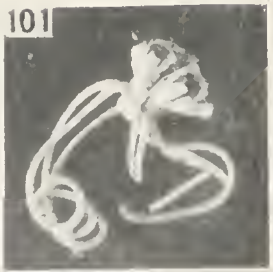
95, 96, *Strotometra hepburniana:* Specimens from the Korean Strait, × 2 (C.M.).

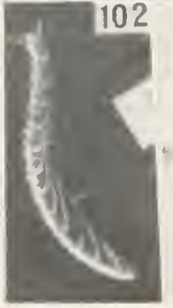
97, *Strotometra priamus:* Type specimen from *Siboga* station 266, × 2 (Amsterdam Mus.).

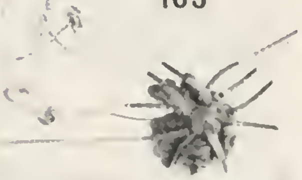

98

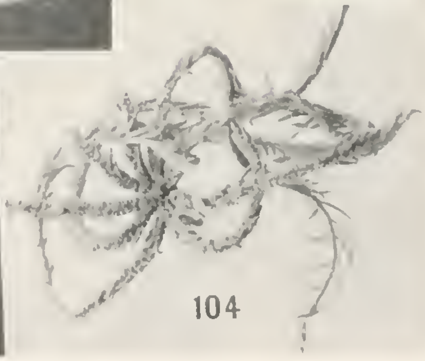

99


100


101


102


103


104

98, *Crinometra brevipinna* var. *inornata:* Type specimen from *Albatross* station 2154, × 2 (U.S.N.M., 25475).

99, *Crinometra brevipinna* var. *insculpta:* Type specimen from *Albatross* station 2753 (U.S.N.M., 25477).

100-103, *Crotalometra sentifera:* 100, 103, Specimen from the Maldive Islands in 914 meters (Cairo, Egypt, Mus.); 101, type specimen from the Laccadive Islands in 1,265 meters (I.M.); 102, distal portion of an arm from the type specimen (I.M.).

104, *Strotometra hepburniana:* Specimen from the Korean Strait, × 2 (C.M.).

INDEX

acoela, Antedon, 116, 192, 194, 245, 354, 355, 357, 358.
  Poecilometra, 115, 116, 245, 265, *355*, 357, 359, 360.
Acoela group, 192, 194, 200.
Actinometra, 3, 39, 100, 279, 280, 343.
  granulifera, 280, 343.
  pulchella, 39, 101, 103, 124.
  sp., 101, 103.
aculeata, Antedon, 191, 202, 204, 206, 222.
  Charitometra, 204, 206, 348.
  Chlorometra, 205, 206.
  Chondrometra, 202 (in key) 203, *204*, 205, 206.
acuta, Daidalometra, 23, 25.
  Stenometra, 25, 26, 27, 28.
acutiradia, Antedon, 1, 119, 132, 133, 134.
  Stiremetra, 120, 121 (in key), 127, *132*, 134, 351.
  Thalassometra, 132.
acutus, Saracrinus, 245.
Adelometra angustiradia, 98, 99.
adriani, Anthometra, 18, 22, 41, 64, 119, 141, 145, 148, 170, 221, 227, 228.
agassizi, Thalassometra, 158.
agassizii, Antedon, 113, 154, 156, 158, 161, 182, 186, 191, 213, 215, 216, 218.
  Myzostoma, 39.
  Thalassometra, 109, 113, 121, 138, 152, 154 (in key), *158*, 160, 161, 162, 180, 182, 186, 191, 213, 215, 216, 218.
Aglaometra, 4, 6 (in key), 91, *107*, 108, 116, 118, 152.
Aglaometra eupedata, 91, 108, 109, 115, 116.
  incerta, 103, 107, 108 (in key), *114*, 116.
  propinqua, 91, 108 (in key), *116*, 117, 118, pl. 15, fig. 47.
  sulcata, 91, 108, 109 (in key), *118*, 119, pl. 13, fig. 40.
  valida, 17, 103, 107, 108 (in key), *109*, 114, 127, 350, pl. 12, fig. 37, pl. 13, figs. 38, 39.
  vera, 91, 108, 116, 118.
ajax, Parametra, 64, 65 (in key), *84*, 86, pl. 9, fig. 29.
alboflava, Antedon, 88, 89.
  Lissometra, *88*, 89, pl. 11, fig. 34.
  Parametra, 88, 89.
  Thalassometra, 88, 89.
Alecto serrata, 30, 38.
alternicirrus, Diplocrinus, 39.
Amphimetra discoidea, 27.
andersoni, Antedon, 1, 191, 192.
  Pontiometra, 1, 191, 192.
angulata, Ophiothrix, 41
angusta, Crinometra brevipinna var., 284, 287, 288, 291 (in key), 329, 330, *335*, 347.
angusticalyx, Antedon, 104, 182, 192, 194, 195, 263, 265, 281, 287, 329, 330, 335, 336, 344, 346, 347.
  Charitometra, 263, 265.
  Glyptometra, 230 (in key), *263*, 357.
  Pachylometra, 265, 266.
  Perissometra, 196, 263, 265, 287, 333, 337, 338.
angustiradia, Adelometra, 98, 99.
  Antedon, 98, 99.
Annacrinus wyville-thomsoni, 39, 104, 106, 121, 124.
annae, Perissometra, 238.
annandalei, Crotalometra, 138, 148, 151.
  Oceanometra, 109, 113, 138 (in key), 139, *144*, 145, 151, pl. 15, figs. 45, 46.
  Thalassometra, 113, 139, 141, 144, 148.
anomala, Cyllometra, 16.
Antedon, 1, 5, 7, 23, 29, 39, 41, 42, 64, 69, 81, 88, 89, 90, 100, 107, 113, 116, 119, 124, 125, 128, 134, 137, 151, 152, 156, 172, 175, 177, 182, 185, 186, 191, 192, 201, 202, 206, 208, 213, 215, 227, 229, 236, 246, 253, 265, 270, 274, 279, 280, 338, 343, 345, 346, 347, 348, 351, 354, 359, 361, 368, 370.
  acoela, 116, 192, 194, 245, 354, 355, 357, 358.
  aculeata, 191, 202, 204, 206, 222.
  acutiradia, 1, 119, 132, 133, 134.
  agassizii, 113, 154, 156, 158, 161, 182, 186, 191, 213, 215, 216, 218.
  alboflava, 88, 89.
  andersoni, 1, 191, 192.
  angusticalyx, 104, 182, 192, 194, 195, 263, 265, 281, 287, 329, 330, 335, 336, 344, 346, 347.
  angustiradia, 98, 99.
  aster, 18, 21, 42, 49, 51, 52.
  basicurva, 103, 125, 182, 191, 348, 351.

Antedon bassett-smithi, 1.
  bifida, 350.
  bispinosa, 1, 154, 155, 156, 160.
  brevicirra, 1.
  brevicuneata, 69.
  brevipinna, 1, 188, 189, 192, 279, 280, 281, 284, 286, 287, 288, 309, 310, 312, 323, 343, 344, 346, 347.
  brevipinna var. concinna, 303, 304.
    var. coronata, 282, 284, 310, 320, 347.
    var. decora, 281, 286, 291, 292, 302, 347.
    var. diadema, 282, 286, 346, 347.
    var. elegans, 281, 282, 287, 298, 303, 310, 346, 347.
    var. gracilis, 282, 286, 296, 302, 346, 347.
    var. granulifera, 316, 317, 319, 320, 321, 331.
    var. granulosa, 286, 325, 347.
    var. insculpta, 286, 304, 305, 306, 308.
    var. laevis, 282, 311, 346, 347.
    var. ornata, 282, 320, 323, 347.
    var. pourtalèsi, 281, 282, 287, 309, 347.
    var. pulchella, 303, 304.
    var. pulchra, 282, 297, 346, 347.
    var. spinosa, 282, 286, 310, 316, 320, 346, 347.
    var. tuberosa, 282, 286, 302, 303, 304, 306, 310, 325, 346, 347.
  breviradia, 1, 124, 126, 127, 128, 133.
  capensis, 192.
  carinata, 63, 338.
  compressa, 1, 65, 66, 69, 70, 71, 72, 192, 194, 196, 348.
  conifera, 7, 13, 17, 18, 21, 22, 51, 56, 57.
  denticulata, 1.
  diadema, 7, 18, 21.
  discoidea, 192, 194.
  distincta, 104, 182, 192, 194, 196, 199, 227, 236, 249, 253, 254.
  duplex, 1, 60, 186, 188, 191, 192.
  echinata, 1, 176, 177.
  elegans, 30, 40.
  eversa, 126, 128.
  fieldi, 1.
  flagellata, 69.
  flava, 101, 104, 105, 106, 107.
  flavomaculata, 1.
  flexilis, 1, 68, 69, 70, 160, 191, 192, 195, 213, 215, 228.
  garrettiana, 194, 198, 202, 204, 206, 221, 222, 223, 227.
  gracilis, 1, 165, 167, 173. 174, 175, 176.
Antedon granulifera, 104, 180, 182, 192, 243, 249, 280, 281, 286, 287, 318, 319, 320, 325, 326, 329, 338, 343, 344, 345, 346, 347.
  hana, 7, 23, 27, 28.
  hawaiiensis, 170.
  hepburniana, 194, 352, 361, 368, 370.
  hirsuta, 175.
  inaequalis, 104, 182, 192, 194, 195, 243, 245, 246, 268, 344.
  incerta, 1, 90, 91, 103, 108, 114, 115, 116.
  incisa, 191, 194, 347, 352, 354.
  inequalis, 243.
  inopinata, 192.
  lata, 272, 274.
  latipinna, 1, 171, 172.
  longicirra, 1.
  lusitanica, 1, 39, 60, 104, 121, 124, 125, 133, 181, 182, 191, 192, 345, 348, 351.
  macronema, 1, 192.
  magnicirra, 90, 97, 99, 108, 192.
  magnicirrus, 97.
  magnicrinus, 97.
  moorei, 1, 66.
  multispina, 1, 101, 103, 104, 125, 160, 180, 181, 182, 183, 192, 345.
  n. sp., 358.
  omissa, 184, 185.
  orion, 18, 21, 64, 65, 72, 82, 194, 196, 348.
  parvipinna, 191, 361, 365, 368.
  patula, 1, 68, 69, 192, 208, 209, 212, 213, 216, 218, 219.
  pergracilis, 173.
  phalangium, 125.
  porrecta, 1, 100, 101, 103, 104, 105, 106, 181, 182, 192, 345.
  pourtalèsi, 1, 192, 280, 284, 287, 309, 310, 320, 345, 347.
  pourtalesii, 280, 344, 345.
  pubescens, 171, 172, 173, 174, 175.
  pusilla, 1.
  quinquecostata, 1, 7, 13, 17, 18, 21, 22, 39, 51, 56, 58, 192.
  radiospina, 126, 128.
  robusta, 1, 69, 160, 192, 208, 213, 218.
  savignyi, 268.
  scalaris, 359, 360.
  sclateri, 192, 268, 269, 270.
  setosa, 182, 183.
  sp., 30, 101, 182, 183, 263, 265, 355.
  spinicirra 1, 133, 136, 137.
  spinifera, 1, 17, 29, 30, 39, 40, 192.
  spinifera var. brevispina, 31, 34, 40.
  tuberosa, 191, 194, 227, 232, 236.
  valida, 1, 17, 90, 91, 103, 108, 109, 113, 115.

Antedon variospina, 126, 129.
vicaria, 1.
villosa, 151, 162, 163.
woodmasoni, 42, 60, 61.
Antedon (Crotalometra), 100.
flava, 105, 107.
lusitanica, 121, 125.
porrecta, 101.
Antedonidae, 1, 22.
Anthometra adriani, 18, 22, 41, 64, 119, 141, 145, 148, 170, 221, 227, 228.
arachnoides, Daidalometra, 23 (in key), *25*, 27, 28, 132, pl. 3, fig. 12.
Stenometra, 25.
Stiremetra, 25, 27.
aranea, Perissometra, 72, 73, 75, 78, 82, 196, 197, 206, 208, 232, 236, 272, 274.
Arcturus pawneeanus, 41.
aster, Antedon, 18, 21, 42, 49, 51, 52.
Cosmiometra, 18, 21, 43 (in key), *49*, 52, 53, 56, pl. 6, fig. 21.
Thalassometra, 49, 52.
Asterometra, 2, 5, 145, 213.
mirifica, 61.
Asterometridae, 1.
attenuata, Thalassometra, 153 (in key), *163*, 165, 167, 173, 174, 175, pl. 17, figs. 53, 54.

basicurva, Antedon, 103, 125, 182, 191, 348, 351.
Charitometra, 103, 125, 205, 321, 330, *348*, 349, 351, 352, 353, 356.
Basicurva group, 1, 5, 121, 125, 181, 188, 190, 191, 200, 345, 357.
bassett-smithi, Antedon, 1.
bengalensis, Heterometra, 243, 276.
bifida, Antedon, 350.
bispinosa, Antedon, 1, 154, 155, 156, 160.
Thalassometra, 152 (in key), *154*, 156, 160.
bocki, Diodontometra, 198, 221, 222, 223, 224, 225, 227.
Bonasa umbellata, 2.
brevicirra, Antedon, 1.
brevicuneata, Antedon, 69.
brevipes, Myzostomum, 345.
brevipinna, Antedon, 1, 188, 189, 192, 279, 280, 281, 284, 286, 287, 288, 309, 310, 312, 323, 343, 344, 346, 347.
Charitometra, 280, 345.
Comatula, 194, 279, 280, 312, 343.
Crinometra, 197, 198, *280*, 281, 286, 287, 288, 289, 300, 302, 312, 346, 347, pl. 30, fig. 90, pl. 31, fig. 93.
Crinometra brevipinna var., 288, 290 (in key), *312*, 347.
brevipinna var. angusta, Crinometra, 284, 287, 288, 291 (in key), 329, 330, *335*, 347.
var. brevipinna, Crinometra, 288, 290 (in key), *312*, 347.
var. concinna, Antedon, 303, 304.
Crinometra, 288, 290 (in key), *298*, 347.
var. coronata, Antedon, 284, 310, 320, 347.
Crinometra, 288, 291 (in key), *320*, 323, 347.
var. decora, Antedon, 281, 286, 291, 292, 302, 347.
Crinometra, 296, 297, 299.
var. diadema, Antedon, 282, 286, 346, 347.
Crinometra, 288, 290 (in key), *308*, 347.
var. elegans, Antedon, 281, 282, 287, 298, 303, 310, 346, 347.
Crinometra, 197.
var. gemmata, Crinometra, 284, 287, 288, 290 (in key), *318*, 330, 347, pl. 30, fig. 92.
var. gracilis, Antedon, 282, 286, 296, 302, 346, 347.
Crinometra, 288, 289 (in key), *296*, 297, 347.
var. granulifera, Antedon, 316, 317, 319, 320, 321, 331.
Crinometra, 288, 290 (in key), 316, *326*, 347.
var. granulosa, Antedon, 286, 325, 347.
Crinometra, 288, 289, 290 (in key), *325*, 347.
var. inornata, Crinometra, pl. 32, fig. 98.
var. insculpta, Antedon, 296, 304, 305, 306, 308.
Crinometra, 284, 288, 289 (in key), *291*, 296, 297, 298, 299, 316, 333, 347, pl. 32, fig. 99.
var. laevis, Antedon, 282, 311, 346, 347.
Crinometra, 290 (in key), *311*, 347.
var. margaritacea, Crinometra, 288, 290 (in key), *307*, pl. 31, fig. 94.
var. ornata, Antedon, 282, 320, 323, 347.
Crinometra, 288, 291 (in key), *323*, 347.
var. pourtalèsi, Antedon, 281, 282, 287, 309, 347.
Crinometra, 288, 290 (in key), *309*, 347.
var. pulchella, Antedon, 303, 304.
Crinometra, 288, 289 (in key), *297*, 299, 300, 347.
var. pulchra, Antedon, 283, 297, 346, 347.
Crinometra, 287, 288, 289, 291 (in key), 326, *334*, pl. 30, fig. 91.

brevipinna var. spinosa, Antedon, 282, 286, 310, 316, 320, 346, 347.
    Crinometra, 288, 289, 290 (in key), *316*, 347.
  var. transversa, Crinometra, 288, 290 (in key), *301*.
  var. tuberosa, Antedon, 282, 286, 302, 303, 304, 306, 310, 325, 346, 347.
    Crinometra, 288, 290 (in key), *303*, 347.
Brevipinna group, 192, 200, 279, 280, 346.
breviradia, Antedon, 1, 124, 126, 127, 128, 133.
  Stiremetra, 120 (in key), 124, *126*, 127, 129, 132, 351.
  Thalassometra, 126.

Calometra, 192, 365.
Calometridae, 192, 194, 247.
Calyptometra, 195, 199, 228, 229, 278.
Calyptometra lateralis, 232, 276, 278.
capensis, Antedon, 192.
carinata, Antedon, 63, 338.
  Perissometra, 72, 73, 77, 78, 82, 196, 197
  Tropiometra, 63, 82, 192, 338.
carinifera, Stiremetra, 120, 121 (in key), *130*, 132.
Charitometra, 1, 5, 64, 65, 66, 69, 81, 82, 152, 192, 194, 195, 196, 199, 200, 201 (in key), 202, 206, 208, 215, 218, 227, 229, 236, 246, 253, 265, 268, 270, 274, 279, 280, 345, *347*, 348, 351, 352, 354, 361, 368.
Charitometra aculeata, 205, 206, 348.
  angusticalyx, 263, 265.
  basicurva, 103, 125, 205, 321, 330, *348*, 349, 351, 352, 353, 356.
  brevipinna, 280, 345.
  compressa, 66, 81, 82.
  distincta, 243, 246, 248, 249.
  flexilis, 214.
  garrettiana, 222, 227.
  granulifera, 280, 345.
  hepburniana, 348, 368, 370.
  imbricata, 280.
  inaequalis, 243, 246, 268, 270.
  incisa, 348 (in key), *352*, 353, 354, 356, 357.
  lata, 272, 274, 278.
  lateralis, 195, 228, 232, 236, 274, 276, 278.
  orion, 81, 82.
  parvipinna, 365, 368.
  patula, 209.
  pourtalèsi, 280, 345.
  robusta, 216.
Charitometra sclateri, 268.
  smithi, 243, 246, 249, 250, 253, 254, 263, 265, 280, 281.
  tuberosa, 232, 236, 278, 348.
Charitometridae, 1, 4, 5, 64, 77, 78, 82, 101, *191*, 192, 194, 196, 197, 198, 199, 200, 201, 202, 208, 224, 228, 236, 265, 268, 270, 279, 288, 348.
Charitometriden, 193.
Charitometrinae, 5, 192, 194, 200, 346.
Chlorometra, 194, 195, 196, 198, 199, 200, 201 (in key), 202, 206, 208, *221*, 222, 227, 348.
  aculeata, 205, 206.
  garrettiana, 204, 206, *222*, 224, 225, 227, pl. 20, fig. 64.
  robusta, 195, 202, 204, 206.
  rugosa, 202, 206, 207.
Chondrometra, 195, 199, 200, *201*, 202, 204, 206, 207, 222.
  aculeata, 199, 202 (in key), 203, *204*, 205, 206.
  robusta, 199, *202*, 203, pl. 19, fig. 60.
  rugosa, 77, 199, 202 (in key), *206*, 207.
Colobometridae, 1, 270.
Comanthus parvicirra, 346.
  rotalaria, 346.
  solaster, 243, 254.
Comaster distincta, 1.
Comasteridae, 333, 357.
comata, Zygometra, 2, 3, 30, 40.
Comatella maculata, 151.
  stelligera, 1, 3.
Comatilia, 1.
Comatula, 279.
  brevipinna, 194, 279, 280, 312, 243.
Comatule, 101.
Comatules, 121.
Comatulida, *1*.
Comatulida Oligophreata, 1.
compressa, Antedon, 1, 65, 66, 69, 70, 71, 72, 192, 194, 196, 348.
  Charitometra, 66, 81, 82.
  Parametra, 64, *65*, 66, 69, 70, 72, 82, 152, pl. 8, fig. 26.
  Thalassometra, 66, 69, 72.
concinna, Antedon brevipinna var., 303, 304.
  Crinometra, 281, 287, 298, 346, 347.
  Crinometra brevipinna var., 288, 290 (in key), *298*, 347.
conifera, Antedon, 7, 13, 17, 18, 21, 22, 51, 56, 57.
  Cosmiometra, 13, 17, 18, 42, 43 (in key), *56*, 58, pl. 3, figs. 10, 11, pl. 4, fig. 15.
  Stenometra, 56.
Conometridae, 20.

coronata, Antedon brevipinna var., 284, 310, 320, 347.
  Crinometra, 282.
  Crinometra brevipinna var., 288, 291 (in key), *320*, 323, 347.
Cosmiometra, 2, 4, 5 (in key), 6, 7, 17, 22, 29, *41*, 42, 47, 52, 58, 59, 61, 64, 152, 185, 186, 191.
Cosmiometra aster, 18, 21, 43 (in key), *49*, 52, 53, 56, pl. 6, fig. 21.
  conifera, 13, 17, 18, 42, 43 (in key), *56*, 58, pl. 3, figs. 10, 11, pl. 4, fig. 15.
  crassicirra, 17, 22, 42, 43 (in key), 56, *58*, 60, 61, 134, 136, pl. 10, fig. 33.
  dasybrachia, 43 (in key), *47*, 49, 52.
  delicata, 42, 43 (in key), 45, *46*, 72, pl. 3, fig. 9.
  gardineri, 43 (in key), 60, 61, *63*.
  helene, 49, 52, 54, 56.
  iole, 43 (in key), *61*, pl. 4, fig. 14.
  koehleri, 42, 186, 191.
  komachi, 42, 49, 52, 56.
  leilae, 42, *43*, 45, 46, pl. 5, fig. 17, pl. 6, fig. 23.
  philippinensis, 43 (in key), 49, *52*, 56, 60, 61, pl. 5, fig. 16, pl. 6, fig. 22.
  woodmasoni, 42, 43 (in key), 56, *60*, 63.
Craspedometra, 99, 149, 152, 269.
crassa, Glyptometra, 196, 229 (in key), *237*, 243, pl. 21, fig. 68.
  Pachylometra, 214, 215, 237, 242, 281, 345.
  Perissometra, 237, 243, 268, 274.
crassicirra, Cosmiometra, 17, 22, 42, 43 (in key), 56, *58*, 60, 61, 134, 136, pl. 10, fig. 33.
  Thalssometra, 42, 58, 59, 136.
Crinometra, 101, 194, 195, 197, 199, 200, 201 (in key), 219, 227, 228, 247, 271, *279*, 280, 281, 282, 287, 319, 320, 335, 345, 346, 347, 348.
  brevipinna, 197, 198, *280*, 281, 286, 287, 288, 289, 300, 302, 312, 346, 347, pl. 30, fig. 90, pl. 31, fig. 93.
  brevipinna var. angusta, 284, 287, 288, 291 (in key), 329, 330, *335*, 347.
    var. brevipinna, 288, 290 (in key), *312*, 347.
    var. concinna, 288, 290 (in key), *298*, 347.
    var. coronata, 288, 291 (in key), *320*, 323, 347.
    var. decora, 296, 297, 299.
    var. diadema, 197, 288, 290 (in key), *308*, 347.
    var. elegans, 197.
    var. gemmata, 284, 287, 288, 290 (in key), *313*, 330, 347, pl. 30, fig. 92.
Crinometra brevipinna var. gracilis, 288, 289 (in key), *296*, 297, 347.
    var. granulifera, 288, 290 (in key), 316, *326*, 347.
    var. granulosa, 288, 289, 290 (in key), *325*, 347.
    var. inornata, pl. 32, fig. 98.
    var. insculpta, 284, 288, 289 (in key), *291*, 296, 297, 298, 299, 316, 333, 347, pl. 32, fig. 99.
    var. laevis, 290 (in key), *311*, 347.
    var. margaritacea, 288, 290 (in key), *307*, pl. 31, fig. 94.
    var. ornata, 288, 291 (in key), *323*, 347.
    var. pourtalèsi, 288, 290 (in key), *309*, 347.
    var. pulchella, 288, 289 (in key), *297*, 299, 300, 347.
    var. pulchra, 287, 288, 289, 291 (in key), 326, *334*, pl. 30, fig. 91.
    var. spinosa, 288, 289, 290 (in key), *316*, 347.
    var. transversa, 288, 290 (in key), *301*.
    var. tuberosa, 288, 290 (in key), *303*, 347.
  concinna, 281, 287, 298, 346, 347.
  coronata, 282.
  gemmata, 281, 318, 326, 346, 347.
  gracilis, 282, 298, 347.
  granulifera, 197, 282, 326, 327, 347, 334, 335.
  imbricata, 282, 326, 327, 331, 332, 347.
  insculpta, 197, 281, 291, 296, 302, 335, 342, 346, 347.
  margaritacea, 281, 307, 346, 347.
  mortenseni, 282.
  ornata, 282, 318, 319, 347.
  pulchra, 197, 281, 287, 297, 327, 334, 335, 346, 347.
  transversa, 197, 282, 301, 302, 303, 347.
cristata, Stenometra, 13, 14, 16, 17, 18, 22.
Crossometra, 101, 195, 196, 198, 199, 228, 229, 232, 248, 254, 266.
  distincta, 246, 248, 249, 250, 254.
  helius, 248, 254, 259.
  investigatoris, 254, 259.
  septentrionalis, 246, 248, 249, 254, 259.
Crotalometra, 6 (in key), *89*, 90, 91, 92, 96, 97, 99, 100, 101, 104, 107, 108, 109, 114, 116, 137, 141, 152.
  annandalei, 138, 148, 151.
  eridanella, 90, 91, 93, 95, 97.
  eupedata, 89, 90, 91, 109, 111, 113, 114, 138, 144, 148.

Crotalometra flava, 90, 91, 104, 105, 107.
  incerta, 91, 108, 114, 116.
  infelix, 90, 91, 92, 94, 97.
  magnicirra, 2, 90, 91 (in key), 93, 95, *97*, 98, 99, 100.
  marginalis, 90, 91, 93, 97, 98, 100.
  marginata, 93, 97.
  porrecta, 90, 91, 101, 102, 104, 107, 181.
  propinqua, 91, 108, 109, 113, 116, 118.
  rustica, 89, 90, 91 (in key), *92*, 95, 97, 98, 99, 108, pl. 11, figs. 35, 36, pl. 18, fig. 53.
  sentifera, 90, *91*, 92, 94, 96, 98, 99, pl. 32, figs. 100–103.
  sulcata, 108, 116, 118, 119.
  valida, 91, 108, 109, 114.
  vera, 108, 116, 117, 118.
Cyllometra anomala, 16.
  manca, 16.

Daidalometra, 5 (in key), 7, 11, *23*, 27, 29, 152.
  acuta, 23, 25.
  arachnoides, 23 (in key), *25*, 27, 28, 132, pl. 3, fig. 12.
  eurymedon, 23 (in key), *24*.
  hana, 7, 11, 23 (in key), *27*, pl. 4, fig. 13.
dasybrachia, Cosmiometra, 43 (in key), *47*, 49, 52.
decora, Antedon brevipinna var., 281, 286, 291, 292, 302, 347.
  Crinometra brevipinna var. 296, 297, 299.
  Stiremetra, 59, 120, 121 (in key), *134*.
delicata, Cosmiometra, 42, 43 (in key), 45, *46*, 72, pl. 3, fig. 9.
  Thalassometra, 42, 46, 47, 72.
dentata, Stenometra, 7, *8*, 11, 18, 22, 23, 27, 29, pl. 5, fig. 18.
denticulata, Antedon, 1.
diadema, Antedon, 7, 18, 21.
  Antedon brevipinna var., 282, 286, 346, 347.
  Crinometra brevipinna var., 288, 290 (in key), *308*, 347.
  Stenometra, 7, 8 (in key), 11, 13, 15, 16, 17, *18*, 21, 58, pl. 2, fig. 5.
  Thalassometra, 18.
Dichrometra flagellata, 69.
Diodontometra, 79, 196, 198, 208, 210, 221, 222, 348.
  bocki, 198, 221, 222, 223, 224, 225, 227.
diplax, Stenometra, 14, 15, 18.
Diplocrinus alternicirrus, 39.
  maclearanus, 39.
discoidea, Amphimetra, 27.
  Antedon, 192, 194.
distincta, Antedon, 104, 182, 192, 194, 196, 199. 227, 236, 249, 253, 254, 344.
  Charitometra, 243, 246, 248, 249.
  Comaster, 1.
  Crossometra, 246, 248, 249, 250, 254.
  Glyptometra, 229 (in key), *249*, 254, pl. 23, figs. 70–72, pl. 24, fig. 73.
  Pachylometra, 198, 249, 250, 253, 254, 263.
dorsata, Stenometra, 13, 17, 18, 22.
duplex, Antedon, 1, 60, 186, 188, 191, 192.
  Horaeometra, 42, 60, 185, *186*, 189, 191, pl. 6, fig. 24.
  Thalassometra, 186.

echinata, Antedon, 1, 176, 177.
  Thalassometra, 153 (in key), *176*, 177, 184, 185.
electrae, Thalassometra, 152, 153 (in key), *156*.
elegans, Antedon, 30, 40.
  Antedon brevipinna var., 281, 282, 287, 298, 303, 310, 346, 347.
  Crinometra brevipinna var., 197.
Endoxocrinus mülleri, 39.
  parrae, 39.
eridanella, Crotalometra, 90, 91, 93, 95, 97.
Essenensis group, 20.
Eudiocrinus, 234.
Eulima, 18, 20.
eupedata, Aglaometra, 91, 108, 109, 114, 116.
  Crotalometra, 89, 90, 91, 109, 111, 113, 114, 138, 144, 148.
europaea, Neocomatella, 103.
eurymedon, Daidalometra, 23 (in key), *24*.
eversa, Antedon, 126, 128.

fieldi, Antedon, 1.
Fimbriata group, 3.
fisheri, Parametra, 64, 65 (in key), 66, 72, *86*, pl. 9, fig. 28.
  Thalassometra, 65, 66, 69, 72, 86, 87.
flagellata, Antedon, 69.
  Dichrometra, 69.
flava, Antedon, 101, 104, 105, 106, 107.
  Antedon (Crotalometra), 105, 107.
  Crotalometra, 90, 91, 104, 107.
  Koehlermetra, 91, 101 (in key), *105*.
  Thalassometra, 105, 107.
flavomaculata, Antedon, 1.
flexilis, Antedon, 1, 68, 69, 70, 160, 191, 192, 195, 213, 215, 228.
  Charitometra, 214.
  Monachometra, 208, 209 (in key), *213*.
  Pachylometra, 214, 215.
  Perissometra, 68, 69, 70, 160, 196, 214, 215, 232, 274.

fluctuans, Zygometra, 2, 3.
fragilis, Monachometra, 73, 79, 208, 209 (in key), *219*, 221, 368, p. 20, figs. 62, 63.
Pachylometra, 195, 208, 219, 221.

gardineri, Cosmiometra, 43 (in key), 60, 61, *63*.
garrettiana, Antedon, 194, 198, 202, 204, 206, 221, 222, 223, 227.
Charitometra, 222, 227.
Chlorometra, 204, 206, *222*, 224, 225, 227, pl. 20, fig. 64.
gemmata, Crinometra, 281, 318, 326, 346, 347.
Crinometra brevipinna var., 284, 287, 288, 290 (in key), *318*, 330, 347, pl. 30, fig. 92.
gigantea, Oceanometra, 138 (in key), *139*, 141, 142, 144, 146, pl. 14, fig. 41.
Thalassometra, 137, 138, 139, 141, 144.
Gislénometra perplexa, 270.
glacialis, Heliometra, 103.
Glenotremites, 20.
Glyptometra, 194, 195, 196, 199, 200, 201 (in key), 208, 213, *227*, 228, 229, 236, 274, 278, 279, 288, 348.
Glyptometra angusticalyx, 230 (in key), *263*, 271, 357.
crassa, 196, 229 (in key), *237*, 243, pl. 21, fig. 68.
distincta, 229 (in key), *249*, 254, pl. 23, figs. 70–72, pl. 24, fig. 73.
gorgonia, 242.
hector, 239.
inaequalis, 198, 229 (in key), *243*.
incerta, 357.
invenusta, 230 (in key), *275*, 278, pl. 29, fig. 89.
investigatoris, 230 (in key), 251, *254*, 256, pl. 24, figs. 74, 75, pl. 25, figs. 76–78.
lata, 76, 196, 230 (in key), *272*, 274, pl. 28, figs. 84–86, pl. 29, fig. 88.
lateralis, 230 (in key), *276*, 278, 364, pl. 29, fig. 87.
levigata, 230 (in key), *271*, pl. 27, figs. 82, 83.
macilenta, 230 (in key), *259*, 275, pl. 26, figs. 79–81.
patula, 196.
sclateri, 230 (in key), *268*.
septentrionalis, 229 (in key), *246*, 257, 269.
sp., 278.
sparksi, 230 (in key), *266*.
timorensis, 229 (in key), *230*, 232, 272, 274, 276, 278, pl. 21, figs. 66, 67.
tuberosa, 77, 195, 198, 203, 205, 229 (in key), *232*, 236, 288, 356, 357, 366, 367, pl. 22, fig. 69.
Glytometra, 228.
gorgonia, Glyptometra, 242.
Perissometra, 241, 242, 243.
gracilis, Antedon, 1, 165, 167, 173, 174, 175, 176.
Antedon brevipinna var., 282, 286, 296, 302, 346, 347.
Crinometra, 282, 298, 347.
Crinometra brevipinna var., 288, 289 (in key), *296*, 297, 347.
Solanocrinus, 173, 176.
Thalassometra, 153 (in key), 163, 165, 167, *173*, 181, 185.
granulata, Parametra, 64, 65 (in key), 66, 67, 68, *69*, 72, 82, pl. 7, fig. 25, pl. 10, figs. 31, 32.
granulifera, Actinometra, 280, 343.
Antedon, 104, 180, 182, 192, 243, 249, 280, 281, 286, 287, 318, 319, 320, 325, 326, 329, 338, 343, 344, 345, 346, 347.
Antedon brevipinna var., 316, 317, 319, 320, 321, 331.
Charitometra, 280, 345.
Crinometra, 197, 282, 326, 327, 347, 334, 335.
Crinometra brevipinna var., 288, 290 (in key), 316, *326*, 347.
Granulifera group, 1, 5, 99, 101, 104, 105, 106, 107, 125, 180, 181, 182, 183, 192, 200, 243, 249, 268, 270, 279, 280, 287, 344, 346, 347.
granulosa, Antedon brevipinna var., 286, 325, 347.
Crinometra brevipinna var. 288, 289, 290 (in key), *325*, 347.
group, Acoela, 192, 194, 200.
Essenensis, 20.
Fimbriata, 3.
Granulifera, 1, 5, 99, 101, 104, 105, 106, 107, 125, 180, 181, 182, 183, 192, 200, 243, 249, 268, 270, 279, 280, 287, 344, 346, 347.
Milberti, 192.
Palmata, 69.
Paradoxus, 20.
Savignyi, 99, 192, 200, 268, 269, 270.
Spinifera, 1, 5, 13, 30, 36, 39, 58, 60, 66, 69, 121, 125, 186, 188, 190, 191, 192, 200, 209, 213, 214, 215, 216, 279, 280, 287, 309, 344, 345, 347.

hana, Antedon, 7, 23, 27, 28.
Daidalometra, 7, 11, 23 (in key), *27*, pl. 4, fig. 13.
Stenometra, 26, 27.
Thalassometra, 27, 28.

hawaiiensis, Antedon, 170.
  Thalassometra, 153 (in key), 169, *170*.
hector, Glyptometra, 239.
helene, Cosmiometra, 49, 52, 54, 56.
Heliometra glacialis, 103.
Heliometrinae, 22, 193.
helius, Crossometra, 248, 254, 259.
  Pachylometra, 246, 248, 254, 257, 259.
hepburniana, Antedon, 194, 252, 361, 368, 370.
  Charitometra, 348, 368, 370.
  Strotometra, 352, 362 (in key), 365, 366, 367, *368*, pl. 31, figs. 95, 96, pl. 32, fig. 104.
Heterometra, 99, 149, 152, 269.
  bengalensis, 243, 276.
Himerometra robustipinna, 192.
Himerometridae, 1, 82, 192, 270, 354, 359, 360, 368, 370.
hirsuta, Antedon, 175.
  Thalassometra, 153 (in key), 163, *165*, 167, 168, 169, 173, pl. 18, fig. 59.
Holocrinus, 263.
Holopus, 193, 279.
Horaeometra, 4, 5, 6 (in key), 152, *185*, 186.
  duplex, 42, 60, 185, *186*, 189, 191, pl. 6, fig. 24.
Hyocrinus, 174.
Hyponome sarsii, 124.

imbricata, Charitometra, 280.
  Crinometra, 282, 326, 327, 331, 332, 347.
  Pachylometra, 281, 345.
inaequalis, Antedon, 104, 182, 192, 194, 195, 243, 245, 246, 268, 344.
  Charitometra, 243, 246, 268, 270.
  Glyptometra, 229 (in key), *243*.
  Pachylometra, 198, 243, 246, 263.
  Perissometra, 333, 337, 338.
incerta, Aglaometra, 103, 107, 108 (in key), *114*, 116.
  Antedon, 1, 90, 91, 103, 108, 114, 115, 116.
  Crotalometra, 91, 108, 114, 116.
  Glyptometra, 357.
  Thalassometra, 114.
incisa, Antedon, 191, 194, 347, 352, 354.
  Charitometra, 348 (in key), *352*, 353, 354, 356, 357.
indica protectus, Stephanometra, 1.
inequalis, Antedon, 243.
infelix, Crotalometra, 90, 91, 92, 94, 97.
  Thalassometra, 91, 92, 97.
inopinata, Antedon, 192.
inornata, Crinometra brevipinna var., pl. 32, fig. 98.
insculpta, Antedon brevipinna var., 286, 304, 305, 306, 308.
  Crinometra, 197, 281, 291, 296, 302, 335, 342, 346, 347.
  Crinometra brevipinna var., 284, 288, 289 (in key), *291*, 296, 297, 298, 299, 316, 333, 347, pl. 32, fig. 99.
invenusta, Glyptometra, 230 (in key), *275*, 278, pl. 29, fig. 89.
  Pachylometra, 259, 275.
  Perissometra, 275, 276.
investigatoris, Crossometra, 254, 259.
  Glyptometra, 230 (in key), 251, *254*, 256, pl. 24, figs. 74, 75, pl. 25, figs. 76–78.
  Pachylometra, 227, 228, 249, 254, 256, 259.
iole, Cosmiometra, 43 (in key), *61*, pl. 4, fig. 14.

koehleri, Cosmiometra, 186, 191.
Koehlermetra, 4, 6 (in key), 90, 91, *100*, 101, 152.
Koehlermetra flava, 91, 101 (in key), *105*.
  porrecta, 91, *101*, 180, 345.
komachi, Cosmiometra, 42, 49, 52, 56.
  Thalassometra, 41, 42, 49, 52.

laevigata, Pachylometra, 271, 272.
laevis, Antedon brevipinna var., 282, 311, 346, 347.
  Crinometra brevipinna var., 290 (in key), *311*, 347.
Lamprometra palmata, 69.
  palmata palmata, 1.
lata, Antedon, 272, 274.
  Charitometra, 272, 274, 278.
  Glyptometra, 76, 196, 230 (in key), *272*, 274, pl. 28, figs. 84–86, pl. 29, fig. 88.
  Perissometra, 195, 196, 230, 232, 272, 274.
lateralis, Calyptometra, 232, 276, 278.
  Charitometra, 195, 228, 232, 236, 274, 276, 278.
  Glyptometra, 230 (in key), *276*, 278, 364, pl. 29, fig. 87.
  Pachylometra, 227, 274.
latipinna, Antedon, 1, 171, 172.
  Thalassometra, 153 (in key), *171*, 172, 185.
leilae, Cosmiometra, 42, *43*, 45, 46, pl. 5, fig. 17, pl. 6, fig. 23.
Leilametra, 4, 6 (in key), *148*, 149, 152.
  necopinata, 148, *149*, pl. 16, figs. 48, 49.
Leptometra, 226.
levigata, Glyptometra, 230 (in key), *271*, pl. 27, figs. 82, 83.
  Pachylometra, 198, 263, 265, 271.
lisa, Parametra, 64, 65 (in key), *83*.

Lissometra, 4, 6 (in key), 42, *88*, 152.
  alboflava, *88*, 89, pl. 11, fig. 34.
longicirra, Antedon, 1.
Lophohelia, 303.
luna, Pachylometra, 254, 256, 259.
lusitanica, Antedon, 1, 39, 60, 104, 121, 124, 125, 133, 181, 182, 191, 192, 345, 348, 351.
  Antedon (Crotalometra), 121, 125.
  Stiremetra, 39, 60, 101, 104, 120 (in key), *121*, 122, 125, 126, 127, 180, 181, 186, 191, 345, 348, 351.
  Thalassometra, 121, 125.

macilenta, Glyptometra, 230 (in key), *259*, 275, pl. 26, figs. 79–81.
  Pachylometra, 216, 219, 259, 263.
  Perissometra, 246, 254, 260, 262.
maclearanus, Diplocrinus, 39.
macronema, Antedon, 1, 192.
maculata, Comatella, 151.
magna, Oceanometra, 138 (in key), 139, 141, *142*, 148, pl. 14, figs. 42, 43.
  Thalassometra, 138, 139, 141, 142, 144, 148.
magnicirra, Antedon, 90, 97, 99, 108, 192.
  Crotalometra, 2, 90, 91 (in key), 93, 95, *97*, 98, 99, 100.
  Thalassometra, 91, 97, 99, 100.
magnicirrus, Antedon, 97.
magnicrinus, Antedon, 97.
magnificus, Moiraster, 302.
manca, Cyllometra, 16.
margaritacea, Crinometra, 281, 307, 346, 347.
  Crinometra brevipinna var., 288, 290 (in key), *307*, pl. 31, fig. 94.
margaritifera, Thalassometra, 153 (in key), 165, *168*, pl. 17, fig. 55.
marginalis, Crotalometra, 90, 91, 93, 97, 98, 100.
  Thalassometra, 92, 95, 97, 100.
marginata, Crotalometra, 93, 97.
  Thalassometra, 153 (in key), *168*, 169.
Mariametra, 279.
  vicaria, 1.
Mariametridae, 84.
Melanella, 20.
  sp., 13.
microdiscus, Zygometra, 124.
Milberti group, 192.
Millericrinus recubariensis, 176, 177, 191.
mirifica, Asterometra, 61.
Moiraster magnificus, 302.
Molpadiidae, 265.
Monachomera, 208.
Monachometra, 79, 195, 196, 199, 201 (in key), *208*, 210, 213, 219, 221.
  flexilis, 208, 209 (in key), *213*.
Monachometra fragilis, 73, 79, 208, 209 (in key), *219*, 221, 368, pl. 20, figs. 62, 63.
  mortenseni, 73, 78, 79, 82, 196, 197, 208, 221.
  patula, 208 (in key), *209*, pl. 20, fig. 61.
  robusta, 196, 208, 209 (in key), *216*.
moorei, Antedon, 1, 66.
mortenseni, Crinometra, 282.
  Monachometra, 73, 78, 79, 82, 196, 197, 208, 221.
mülleri, Endoxocrinus, 39.
multispina, Antedon, 1, 101, 103, 104, 125, 160, 180, 181, 182, 183, 192, 345.
  Thalassometra, 102, 103, 125, 154 (in key), 160, 179, *180*, 181, 182, 183, 345.
Myzostoma agassizii, 39.
Myzostomum brevipes, 345.
  pictum, 39.

Nanometra, 192.
necopinata, Leilametra, 148, *149*, pl. 16, figs. 48, 49.
Neocomatella europaea, 103.
  pulchella, 39, 124.

occidentalis, Perissometra, 237, 243, 260, 261, 262, 263, 268.
Oceanometra, 4, 6 (in key), *137*, 138, 141, 148, 152.
  annandalei, 109, 113, 138 (in key), *144*, 145, 148, 151, pl. 15, figs. 45, 46.
  gigantea, 138 (in key), *139*, 141, 142, 144, 146, pl. 14, fig. 41.
  magna, 138 (in key), 139, 141, *142*, 144, 148, pl. 14, figs. 42, 43.
Oligophreata, *1*, 2, 193.
omissa, Antedon, 184, 185.
  Thalassometra, 154 (in key), *184*, 185.
Ophiothrix angulata, 41.
orion, Antedon, 18, 21, 64, 65, 72, 82, 194, 196, 348.
  Charitometra, 81, 82.
  Parametra, 18, 21, 64, 65 (in key), *72*, 78, 80, 82, 152, 196, 197, 208, 221, 232, 274, pl. 5, figs. 19, 20, pl. 8, fig. 27, pl. 10, fig. 30.
  Thalassometra, 72.
ornata, Antedon brevipinna var., 282, 320, 323, 347.
  Crinometra, 282, 318, 319, 347.
  Crinometra brevipinna var., 288, 291 (in key), *323*, 347.
ornatissimns, Strotometra, 362.
ornatissimus, Strotometra, 361 (in key), *362*, pl. 20, fig. 65.

Pachyantedon, 176.
Pachylometra, 101, 158, 192, 194, 195, 196, 197, 199, 200, 208, 213, 215, 219, 227, 228, 229, 246, 248, 253, 254, 270, 272, 279, 346, 348.
  angusticalyx, 265, 266.
  crassa, 214, 215, 281, 237, 242, 345.
  distincta, 198, 249, 250, 253, 254, 263.
  flexilis, 214, 215.
  fragilis, 195, 208, 219, 221.
  helius, 246, 248, 254, 257, 259.
  imbricata, 281, 345.
  inaequalis, 198, 243, 246, 263.
  invenusta, 259, 275.
  investigatoris, 227, 228, 249, 254, 256, 259.
  laevigata, 271, 272.
  lateralis, 227, 274.
  levigata, 198, 263, 265, 271.
  luna, 254, 256, 259.
  macilenta, 216, 219, 259, 263.
  n. sp. 266, 268.
  patula, 209. 213.
  robusta, 216, 219, 260, 261.
  sclateri, 193, 268, 270.
  selene, 249, 253, 254.
  septentrionalis, 195, 246, 248, 249.
  smithi, 249, 253.
palmata, Lamprometra, 69.
Palmata group, 69.
palmata palmata, Lamprometra, 1.
Paradoxus group, 20.
Parametra, 4, 5, 6 (in key), 42, *64*, 65, 69, 72, 78, 82, 87, 88, 152, 194, 196, 200, 348.
  ajax, 64, 65 (in key), *84*, 86, pl. 9, fig. 29.
  alboflava, 88, 89.
  compressa, 64, *65*, 66, 69, 70, 72, 82, 152, pl. 8, fig. 26.
  fisheri, 64, 65 (in key), 66, 72, *86*, pl. 9, fig. 28.
  granulata, 64, 65 (in key), 66, 67, 68, *69*, 72, 82, pl. 7, fig. 25, pl. 10, figs. 31, 32.
  lisa, 64, 65 (in key), *83*.
  orion, 18, 21, 64, 65 (in key), *72*, 77, 78, 80, 82, 152, 196, 197, 208, 221, 232, 274, pl. 5, figs. 19, 20, pl. 8, fig. 27, pl. 10, fig. 30.
parrae, Endoxocrinus, 39.
parvicirra, Comanthus, 346.
parvipinna, Antedon, 191, 361, 365, 368.
  Charitometra, 365, 368.
  Strotometra, 196, 361 (in key), *365*, 368, 370.
patula, Antedon, 1, 68, 69, 192, 208, 209, 212, 213, 216, 218, 219.
  Charitometra, 209.
patula, Glyptometra, 196.
  Monachometra, 208 (in key), *209*, pl. 20, fig. 61.
  Pachylometra, 209, 213.
  Perissometra, 68, 69, 195, 196, 209, 213, 232, 274.
pawneeanus, Arcturus, 41.
Pentacrinus wyville-thomsoni, 121, 124.
pergracilis, Antedon, 173.
  Thalassometra, 163, 173, 175, 176, 185.
peripolos, Thalassometra, 154 (in key), *178*, 180, pl. 18, figs. 56, 57.
Perissometra, 158, 195, 196, 199, 208, 213, 215, 219, 228, 229, 232, 242, 243, 254, 262, 265, 266, 274, 275.
Perissometra angusticalyx, 196, 263, 265, 287, 333, 337, 338.
  annae, 238.
  aranea, 72, 73, 75, 78, 82, 196, 197, 206, 208, 232, 236, 272, 274.
  carinata, 72, 73, 77, 78, 82, 196, 197.
  crassa, 237, 243, 268, 274.
  flexilis, 68, 69, 70, 160, 196, 214, 215, 232, 274.
  gorgonia, 241, 242, 243.
  inaequalis, 333, 337, 338.
  invenusta, 275, 276.
  lata, 195, 196, 230, 232, 272, 274.
  macilenta, 246, 254, 260, 262.
  occidentalis, 237, 243, 260, 261, 262, 263, 268.
  patula, 68, 69, 195, 196, 209, 213, 232, 274.
  robusta, 69, 160, 209, 216.
  selene, 249, 251, 254.
  sparksi, 266, 268.
  timorensis, 196, 230, 232, 272, 274, 276.
Perometrinae, 1.
perplexa, Gislénometra, 270.
  Stiremetra, 120, 121 (in key), *129*, pl. 14, fig. 44.
  Thalassometra, 129, 173, 175.
phalangium, Antedon, 125.
philippinensis, Cosmiometra, 43 (in key), 49, *52*, 56, 60, 61, pl. 5, fig. 16, pl. 6, fig. 22.
pictum, Myzostomum, 39.
Poecilometra, 1, 5, 192, 194, 195, 196, 201 (in key), 199, 200, 348, *354*, 355, 359, 360.
Poecilometra acoela, 115, 116, 245, 265, *355*, 357, 359, 360.
  scalaris, 355 (in key), 358, *359*, 360.
Pontiometra andersoni, 1, 191, 192.
porrecta, Antedon, 1, 100, 101, 103, 104, 105, 106, 181, 182, 192, 345.
  Antedon (Crotalometra), 101.

porrecta, Crotalometra, 90, 91, 101, 102, 104, 107, 181.
  Koehlermetra, 91, *101*, 180, 345.
  Thalassometra, 101, 104.
propinqua, Crotalometra, 91, 108, 109, 113, 116, 118.
pourtalèsi, Antedon, 1, 192, 280, 284, 287, 309, 310, 320, 345, 347.
  Antedon brevipinna var., 281, 282, 287, 309, 347.
  Charitometra, 280, 345.
  Crinometra brevipinna var., 288, 290 (in key), *309*, 347.
pourtalesii, Antedon, 280, 344, 345.
priamus, Strotometra, 361 (in key), *363*, 365, pl. 31, fig. 97.
Promachocrinus, 2.
propinqua, Aglaometra, 91, 108 (in key), *116*, 117, 118, pl. 15, fig. 47.
protectus, Stephanometra indica, 1.
Psathyrometra, 115.
Pterometra, 2, 5.
Ptilometra, 2, 3, 5.
  splendida, 263, 265.
Ptilometridae, 1, 192.
Ptilometrinae, 5.
pubescens, Antedon, 171, 172, 173, 174, 175.
  Thalassometra, 165, 167, 173, 175, 176.
pulchella, Actinometra, 39, 101, 103, 124.
  Antedon brevipinna var., 303, 304.
  Crinometra brevipinna var., 288, 289 (in key), *297*, 299, 300, 347.
  Neocomatella, 39, 124.
pulchra, Antedon brevipinna var., 282, 297, 346, 347.
  Crinometra, 197, 281, 287, 297, 327, 334, 335, 346, 347.
  Crinometra brevipinna var., 287, 288, 291 (in key), 326, *334*, pl. 30, fig. 91.
pusilla, Antedon, 1.

quinquecostata, Antedon, 1, 7, 13, 17, 18, 21, 22, 39, 51, 56, 58, 192.
  Stenometra, 7, 8 (in key), *13*, 16, 17, 18, 21, 30, 39, 58, pl. 1, figs. 2, 3, pl. 2, figs. 4, 6, 7.
  Thalassometra, 13, 18, 21, 22.

radiospina, Antedon, 126, 128.
recubariensis, Millericrinus, 176, 177, 191.
robusta, Antedon, 1, 69, 160, 192, 208, 213, 218.
  Charitometra, 216.
  Chlorometra, 202, 204, 206.
  Chondrometra, 199, *202*, 203, pl. 19, fig. 60.
robusta, Monachometra, 196, 208, 209 (in key), *216*.
  Pachylometra, 216, 219, 260, 261.
  Perissometra, 69, 160, 209, 216.
robustipinna, Himerometra, 192.
rodstomi, Scalpellum, 41.
rotalaria, Comanthus, 346.
rugosa, Chlorometra, 202, 206, 207.
  Chondrometra, 77, 199, 202 (in key), *206*, 207.
rugosus, Uroptychus, 41.
rustica, Crotalometra, 89, 90, 91 (in key), *92*, 95, 97, 98, 99, 108, pl. 11, figs. 35, 36, pl. 18, fig. 53.
  Thalassometra, 91, 92, 97.

Saracrinus acutus, 245.
sarsii, Hyponome, 124.
savignyi, Antedon, 268.
Savignyi group, 99, 192, 200, 268, 269, 270.
scalaris, Antedon, 359, 360.
  Poecilometra, 355 (in key), 358, *359*, 360.
Scalpellum, 41.
  rodstomi, 41.
sclateri, Antedon, 192, 268, 269, 270.
  Charitometra, 268.
  Glyptometra, 230 (in key), *268*.
  Pachylometra, 193, 268, 270.
selene, Pachylometra, 249, 253, 254.
  Perissometra, 249, 251, 254.
sentifera, Crotalometra, 90, *91*, 92, 94, 96, 98, 99, pl. 32, figs. 100–103.
  Thalassometra, 91, 92.
septentrionalis, Crossometra, 246, 248, 249, 254, 259.
  Glyptometra, 229 (in key), *246*, 257, 269.
  Pachylometra, 195, 246, 248, 249.
serrata, Alecto, 30, 38.
setosa, Antedon, 182, 183.
  Thalassometra, 154 (in key), 180, 181, *182*, 183.
smithi, Charitometra, 243, 246, 249, 250, 253, 254, 263, 265, 280, 281.
  Pachylometra, 249, 253.
snelliusi, Stenometra, 7, 8, *12*, 22, pl. 1, fig. 1.
Solanocrinus gracilis, 173, 176.
solaster, Comanthus, 243, 254.
sparksi, Glyptometra, 230 (in key), *266*.
  Perissometra, 266, 268.
spicata, Stephanometra, 18.
spinicirra, Antedon, 133, 136, 137.
  Stiremetra, 120, 121 (in key), 127, 132, 133, *136*.
  Thalassometra, 136.

spinifera, Antedon, 1, 17, 29, 30, 39, 40, 192.
  Stylometra, 17, 29, *30*, 39, 40, 41, 42, 120, 188, pl. 3, fig. 8.
  Thalassometra, 30, 40.
spinifera var. brevispina, Antedon, 31, 34, 40.
Spinifera group, 1, 5, 13, 30, 36, 39, 58, 60, 66, 69, 121, 125, 186, 188, 190, 191, 192, 200, 209, 213, 214, 215, 216, 279, 280, 287, 309, 344, 345, 346, 347.
spinosa, Antedon brevipinna var., 282, 286, 310, 316, 320, 346, 347.
  Crinometra brevipinna var., 288, 289, 290 (in key), *316*, 347.
splendida, Ptilometra, 263, 265.
stelligera, Comatella, 1, 3.
Stenometra, 4, 5 (in key), *7*, 11, 16, 17, 18, 21, 23, 28, 41, 58, 152, 155.
  acuta, 25, 26, 27, 28.
  arachnoides, 25.
  conifera, 56.
  cristata, 13, 14, 16, 17, 18, 22.
  dentata, 7, *8*, 11, 18, 22, 23, 27, 29, pl. 5, fig. 18.
  diadema, 7, 8 (in key), 11, 13, 15, 16, 17, *18*, 21, 51, 58, pl. 2, fig. 5.
  diplax, 14, 15, 18.
  dorsata, 13, 17, 18, 22.
  hana, 26, 27.
  quinquecostata, 7, 8 (in key), *13*, 16, 17, 18, 21, 30, 39, 58, pl. 1, figs. 2, 3, pl. 2, figs. 4, 6, 7.
  snelliusi, 7, 8 (in key), *12*, 22, pl. 1, fig. 1.
Stephanometra indica protectus, 1.
  spicata, 18.
Stiremetra, 4, 5, 6 (in key), 23, 108, *119*, 120, 128, 129, 132, 137, 152.
  acutiradia, 120, 121 (in key), 127, *132*, 134, 351.
  arachnoides, 25, 27.
  breviradia, 120 (in key), 124, *126*, 127, 129, 132, 351.
  carinifera, 120, 121 (in key), *130*, 132.
  decora, 59, 120, 121 (in key), *134*.
  lusitanica, 39, 60, 101, 104, 120 (in key), *121*, 122, 125, 126, 127, 180, 181, 186, 191, 345, 348, 351.
  perplexa, 120, 121 (in key), *129*, pl. 14, fig. 44.
  spinicirra, 120, 121 (in key), 127, 132, 133, *136*.
Strotometra, 194, 195, 198, 199, 200, 201 (in key), 348, *361*, 368.
  hepburniana, 352, 362 (in key), 365, 366, 367, *368*, pl. 31, figs. 95, 96, pl. 32, fig. 104.
Strotometra ornatissimus, 362.
  ornatissimus, 361 (in key), *362*, pl. 20, fig. 65.
  parvipinna, 196, 361 (in key), *365*, 368, 370.
  priamus, 361 (in key), *363*, 365, pl. 31, fig. 97.
Stylometra, 1, 4, 5 (in key), *29*, 40, 41, 42, 152.
  sp., 30.
  spinifera, 17, 29, *30*, 39, 40, 41, 42, 120, 188, pl. 3, fig. 8.
sulcata, Aglaometra, 91, 108, 109 (in key), *118*, 119, pl. 13, fig. 40.
  Crotalometra, 108, 116, 118, 119.

Thalassometra, 1, 2, 4, 5, 6 (in key), 7, 17, 21, 23, 28, 29, 40, 41, 42, 52, 61, 64, 65, 66, 69, 72, 81, 82, 88, 89, 90, 91, 97, 100, 101, 105, 107, 108, 113, 114, 115, 116, 119, 125, 126, 128, 134, 137, 138, 141, 144, 149, *151*, 152, 156, 161, 162, 163, 165, 170, 172, 175, 176, 182, 183, 185, 186, 191, 192.
  acutiradia, 132.
  agassizi, 158.
  agassizii, 109, 113, 121, 138, 152, 154, (in key), *158*, 160, 161, 162, 180, 182, 186, 191, 213, 215, 216, 218.
  alboflava, 88, 89.
  annandalei, 113, 139, 141, 144, 148.
  aster, 49, 52.
  attenuata, 153 (in key), *163*, 165, 167, 173, 174, 175, pl. 17, figs. 53, 54.
  bispinosa, 152, (in key), *154*, 156, 160.
  breviradia, 126.
  compressa, 66, 69, 72.
  crassicirra, 42, 58, 59, 136.
  delicata, 42, 46, 47, 72.
  diadema, 18.
  duplex, 186.
  echinata, 153 (in key), *176*, 177, 184,185.
  electrae, 152, 153 (in key), *156*.
  fisheri, 65, 66, 69, 72, 86, 87.
  flava, 105, 107.
  gigantea, 137, 138, 139, 141, 144.
  gracilis, 153 (in key), 163, 165, *173*, 181, 185.
  hana, 27, 28.
  hawaiiensis, 40, 153 (in key), 169. *170*.
  hirsuta, 153 (in key), 163, *165*, 167, 168, 169, 173, pl. 18, fig. 59.
  incerta, 114.
  infelix, 91, 92, 97.
  komachi, 41, 42, 49, 52.
  latipinna, 153 (in key), *171*, 172, 185.
  lusitanica, 121, 125.

Thalassometra magna, 138, 139, 141, 142, 144, 148.
magnicirra, 91, 97, 99, 100.
margaritifera, 153 (in key), 165, *168*, pl. 17, fig. 55.
marginalis, 92, 95, 97, 100.
marginata, 153 (in key), *168*, 169.
multispina, 102, 103, 125, 154 (in key), 160, 179, *180*, 181, 182, 183, 345.
omissa, 154 (in key), *184*, 185.
orion, 72.
pergracilis, 163, 173, 175, 176, 185.
peripolos, 154 (in key), *178*, 180, pl. 18, figs. 56, 57.
perplexa, 129, 173, 175.
porrecta, 101, 104.
pubescens, 165, 167, 173, 175, 176.
quinquecostata, 13, 18, 21, 22.
rustica, 91, 92, 97.
sentifera, 91, 92.
setosa, 154 (in key), 180, 181, *182*, 183.
sp., 156, 158, 185.
spinicirra, 136.
spinifera, 30, 40.
valida, 109.
villosa, 152, 154 (in key), *162*, 163, pl. 17, figs. 50–52.
woodmasoni, 60.
Thalassomètres, 3.
Thalassometridae, *1*, 3, 4, 5, 7, 23, 27, 29, 42, 64, 65, 77, 78, 82, 84, 88, 90, 97, 98, 99, 100, 101, 104, 105, 107, 108, 109, 113, 114, 116, 119, 121, 125, 134, 137, 141, 148, 151, 152, 156, 163, 171, 172, 175, 177, 182, 186, 191, 192, 194, 196, 197, 200, 236, 270, 345, 347, 348, 354, 359, 360, 368, 370.
Thalassometrinae, 3, 5, 40, 91, 101, 108, 180, 186.
Thalassometriden, 3.
Thaumatocrinus, 101.
Thaumatometra, 158.
timorensis, Glyptometra, 229 (in key), *230*, 232, 272, 274, 276, 278, pl. 21, figs. 66, 67.
Perissometra, 196, 230, 232, 272, 274, 276.
transversa, Crinometra, 197, 282, 301, 302, 303, 347.
Crinometra brevipinna var., 288, 290 (in key), *301*.
Tropiometra carinata, 63, 82, 192, 338.
Tropiometrida, 1, 3, 193.
Tropiometridae, 2, 3, 5.
tuberosa, Antedon, 191, 194, 227, 232, 236.
Antedon brevipinna var., 282, 286, 302, 303, 304, 306, 310, 325, 346, 347.
Charitometra, 232, 236, 278, 348.
Crinometra brevipinna var., 288, 290 (in key), *303*, 347.
Glyptometra, 77, 195, 198, 203, 205, 229 (in key), *232*, 236, 288, 356, 357, 366, 367, pl. 22, fig. 69.

umbellata, Bonasa, 2.
Uroptychus rugosus, 41.

valida, Aglaometra, 17, 103, 107, 108 (in key), *109*, 114, 127, 350, pl. 12, fig. 37, pl. 13, figs. 38, 39.
Antedon, 1, 17, 90, 91, 103, 108, 109, 113, 115.
Crotalometra, 91, 108, 109, 114.
Thalassometra, 109.
variospina, Antedon, 126, 129.
vera, Aglaometra, 91, 108, 116, 118.
Crotalometra, 108, 116, 117, 118.
vicaria, Antedon, 1.
Mariametra, 1.
villosa, Antedon, 151, 162, 163.
Thalassometra, 152, 154 (in key), *162*, 163, pl. 17, figs. 50–52.

woodmasoni, Antedon, 42, 60, 61.
Cosmiometra, 42, 43 (in key), 56, *60*, 63.
Thalassometra, 60.
wyville-thomsoni, Annacrinus, 39, 104, 106, 121, 124.
Pentacrinus, 121, 124.

Zygometra comata, 2, 3, 30, 40.
fluctuans, 2, 3.
microdiscus, 124.

NEW NAMES

New genus.—*Koehlermetra*, p. 100.

New species.—*Daidalometra eurymedon*, p. 24; *Cosmiometra iole*, p. 61; *Parametra lisa*, p. 83; *Stiremetra decora*, p. 134.

New varieties.—*Crinometra brevipinna* var. *pulchella*, p. 297; *Crinometra brevipinna* var. *angusta*, p. 335.

New names.—*Glyptometra annae*, p. 238; *Glyptometra hector*, p. 239.

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 01421 1353